Enhancing Transportation Project Delivery Through Watershed Characterization

I-405 Case Study

Report to the WSDOT Urban Corridors Office

Authors

Richard Gersib

Brent Haddaway

Tim Hilliard

Ed Molash

Jim Park

Albert Perez

Virginia Stone

January, 2004

Table of Contents

Table of Tables

Table of Figures

List of Appendices

Acknowledgments

The Watershed Characterization Technical Team has been fortunate in having the assistance of a group of highly talented individuals during the development of this report. The following people were especially helpful.

Craig Broadhead, Washington State Department of Transportation

Kurt Buchanan, Washington State Department of Fish and Wildlife

Tanya Johnson, Washington State Department of Transportation

Foroozan Labib, PhD, Washington State Department of Ecology

William P. Leonard, Washington State Department of Transportation

Chris May, PhD, Battelle Northwest

William Null, PhD, Washington State Department of Transportation

Kathy Prosser, Washington State Department of Transportation

In addition, we would like to acknowledge the generous assistance of staff from many other organizations including the City of Bellevue, the City of Newcastle, the City of Renton, King County, the Muckleshoot Tribe, the Northwest Indian Fisheries Commission, the Washington State Department of Transportation's Urban Corridor Office, and Water Resource Inventory Area 8 Technical Committee.

We especially thank the Federal Highway Administration, and FHWA managers Mary Gray and Sharon Love, for the confidence they have shown in our vision and the substantial financial support provided. Without this grant funding, the following work would not have been possible.

List of Acronyms and Abbreviations

ADT	Average Daily Traffic
cfs	Cubic Feet per Second
DAU	Drainage Analysis Unit
DFW	Washington State Department of Fish and Wildlife
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EMC	Event Mean Concentrations
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
I-405	Interstate 405
I-90	Interstate 90
LIDAR	Light Detection And Ranging
LWD	Large Woody Debris
TIA	Total Impervious Area
WRIA	Water Resources Inventory Area
WSDOT	Washington State Department of Transportation

I. Executive Summary

This document presents the work of an interdisciplinary technical team of scientists charged with developing, implementing, and refining watershed characterization methods that support transportation project delivery. We focus our efforts on a seven-mile transportation project on I-405 in King County, Washington. This project extends from the Cedar River bridge in the City of Renton, north to a point immediately south of the I-90/I-405 interchange. It crosses portions of the Cedar River, May Creek, and Coal Creek watersheds, as well as smaller basins that drain directly to Lake Washington.

This report provides the I-405 North Renton project management team with technical information and options for them to consider when fulfilling their regulatory requirements to avoid, minimize, and compensate for stormwater and unavoidable natural resource impacts of the transportation project. This report also serves a secondary role in documenting the continued development and refinement of watershed characterization methods.

Our goal is to provide the project management team with information and alternative mitigation options which have the potential to increase environmental benefits while reducing mitigation costs.

Watershed characterization is a developing technical tool that seeks to answer the question: *Where should we target natural resource improvements to mitigate impacts of a transportation project while achieving the greatest environmental benefit at reduced cost?* Through watershed characterization, we seek to integrate the mitigation of wetland, riparian, floodplain, and stormwater impacts by restoring the landscape's capacity to function. We do this by assessing the condition of ecological processes, such as the movement of water, sediment, pollutants, large wood, and heat. We then target restoration to degraded natural wetlands, riparian areas, and floodplains having the greatest potential to mitigate project impacts and result in measurable environmental benefits. We placed a special focus on the development of tools having potential to help compensate for the stormwater impacts.

Our goal is to provide the project management team with information and alternative mitigation options which have the potential to increase environmental benefits while reducing mitigation costs.

To achieve this goal, we first gain understanding of the location and condition of natural resources at both the project site scale and a larger landscape scale. At the project site scale, we establish a worst-case scenario of project impacts to existing natural resources that will be reduced through avoidance and minimization efforts by the design team. We also present a ranking of existing wetland sites within the project area to assist the project management team in their decision-making process to avoid and minimize impacts to wetland resources.

At the landscape scale, we characterize the condition of key ecological processes that the transportation project impacts. We do this by interpreting existing land cover and natural resource data and by developing databases that identify the location and condition of wetland, riparian, and floodplain resources. We identify targeted landscape areas having the potential to restore key ecological processes.

Next, we identify candidate mitigation sites using the wetland, riparian, and floodplain data. In addition to these natural resource datasets, we developed a stormwater retrofit database to provide alternative mitigation options for treating stormwater in urban areas where few viable natural resource options exist. The technical team then established priority ranking criteria. With these criteria, we develop and present here two priority lists of mitigation opportunities, presented in detail as Appendix A and Appendix B.

The stormwater mitigation priority list (Appendix A) is intended specifically for identifying potential wetland, riparian, and floodplain restoration sites as well as stormwater retrofit options that have potential to mitigate stormwater flow control impacts of the transportation project.

The natural resource mitigation priority list (Appendix B) is also intended to provide options to the project management team, for the mitigation of wetland, riparian, floodplain, and habitat mitigation needs of the project.

II. Introduction

Watershed characterization is a developing technical tool that seeks to answer the question "where should we target natural resource improvements to mitigate impacts of a transportation project while achieving the greatest environmental benefit at reduced cost?"

Transportation planners have a variety of tools for identifying mitigation sites. These range from reviewing topography maps and conducting drive-by surveys to sophisticated modeling efforts. Often, in the past, our goal has simply been to get the project permitted, and this is what we have developed most of the available tools for. However, if our goal is to answer the question above, it will require new tools.

> ***"Where should we target natural resource improvements to mitigate impacts of a transportation project while achieving the greatest environmental benefit at reduced cost?"***

This report represents the work of an interdisciplinary technical team of scientists. It presents results of watershed characterization on the North Renton section of the I-405 corridor, and represents the second test of the methodology. We present the report to the I-405 project management team as a technical tool and set of recommendations for their consideration. The report includes:

- Technical information for use in the permitting process
- A prioritized list of project area wetlands to consider in the design phase for avoidance and minimization
- A prioritized list of out of right-of-way options to mitigate potential stormwater impacts
- A prioritized list of out of right-of-way options to mitigate natural resource and habitat impacts
- Supporting documentation

We believe this suite of alternative mitigation options has potential to mitigate project impacts to regulated natural resources, provide increased environmental benefit, and reduce mitigation cost on the seven-mile North Renton section of the I-405 corridor in King County, Washington.

> ***This report is presented to the project management team as a technical tool and a set of recommendations for their consideration.***

Through watershed characterization, we seek to integrate the mitigation of wetland, riparian, floodplain, and stormwater impacts by restoring the landscape's capacity to function. Existing Best Management Practices (BMPs) for stormwater often equate to large engineered detention ponds or underground vaults designed to capture and store highway runoff before it reaches a stream system. These BMPs are expensive to build and maintain and provide only the functions intended, which are water quality and quantity treatment. Watershed characterization methods allow mitigation efforts to focus on restoring the natural capacity of the landscape to store and clean water. These functions can be provided through the restoration of degraded wetland, riparian, or floodplain systems or the removal of existing impervious area. By reestablishing these self-maintaining ecological systems, we provide the needed water quality and quantity treatment along with a suite of other functions and values important to society.

Watershed characterization objectives for the I-405 North Renton project are:

- Deliver a prioritized list of potential mitigation sites to the project management team
- Refine and add to existing watershed characterization methods
- Develop (in concert with the Department of Ecology) reproducible methods that identify and quantify the stormwater flow control capabilities of potential wetland, riparian, and floodplain restoration sites
- Present methods, assumptions, and results in a manner that is comprehensive and understandable

The truest measure of success will be on-the-ground application of watershed characterization methods leading to recommended sites actually being used for mitigation of project impacts.

We placed a special focus on the development of tools having potential to help compensate for the stormwater impacts. The Departments of Transportation and Ecology made a joint decision to focus tool development on stormwater flow control. We especially want to thank the Department of Ecology for supporting this effort by allowing an Ecology stormwater engineer, Dr. Foroozan Labib, to participate on our technical team and provide insight and guidance on stormwater issues. Conversely, unresolved policy issues related to the Endangered Species Act (ESA) resulted in a decision not to develop and refine tools for direct and indirect effects of ESA listed species. In the same way that Ecology and Transportation worked cooperatively to address stormwater issues, we are hopeful that we will be able to address ESA issues in the future using a similarly cooperative approach with the appropriate state and federal agencies.

An interdisciplinary technical team of scientists completed this report, but our goal is to make it clear and understandable to the average person. To do this, we have chosen a format that seeks to tell the story of the study area and of our results, rather than present a large detailed report with pages of data in a more formal technical format. This format is made possible by our use of a separate detailed methods document and by extensive use of the appendices in this report. We are hopeful that this format will be more understandable for the non-technical reader and yet ensure that all methods, data, assumptions, and results are readily accessible to technical and regulatory reviewers.

III. Characterizing the Study Area

1. A Landscape-Scale Perspective

An understanding of overall landscape condition is needed to most effectively target mitigation and recovery actions. This landscape-scale perspective provides context for project impacts, and gives us the information we need to rate potential mitigation sites.

Mitigation is most effective when it restores core ecological processes. We therefore need to understand how these processes function within each drainage basin, and how they have been altered by human land use. We begin by describing the geography of the study area, with a focus on existing and future land use. We use this information to establish the appropriate spatial scales for the analysis. We then describe the relationships between geology, subsurface flow, and surface flow so we can understand how water, sediment, nutrients, and pollutants move through the landscape. We assess biologic resources within the study area to understand the condition of fish and wildlife habitats and populations. We also review local watershed planning efforts and identify local priorities so we can maximize the synergy between mitigation projects and local restoration activities.

> ***Mitigation is most effective when it restores core ecological processes. We therefore need to understand how these processes function within each drainage basin, and how they have been altered by human land use.***

This information is integrated into an overall assessment of the core ecological process within each landscape unit. We use geographic information system (GIS) mapping to identify areas in the landscape where ecological processes are properly functioning, at risk, and not properly functioning. This allows us to focus our analysis on the at-risk areas, where mitigation will be sustainable and can provide the highest level of environmental benefit.

2. Geography

The study area for this document is a group of watersheds and partial watersheds, totaling approximately 68.5 square miles, which each drain into Lake Washington. Lake Washington is the second largest natural lake in Washington State. Approximately 22 miles long, with over 50 miles of shoreline, it lies at an altitude of approximately 22 feet and in places exceeds 200 feet in depth. All the watersheds and partial watersheds in the study area are part of Water Resource Inventory Area (WRIA) 8, “Lake Washington / Cedar River.” The study area contains the entire watersheds of May Creek and Coal Creek, the lower parts of the Cedar River Watershed (up to the point where State Highway 18 crosses the river), and three small combined watersheds draining directly into Lake Washington. Each of these drainages has similarities and differences in geology, topography, precipitation, and human land use. We introduce these subjects below, or discuss them in greater detail in subsequent sections of the document.

Most of the study area near Lake Washington is part of the three incorporated cities of Bellevue (north), Newcastle (center), and Renton (south). Almost all of Coal Creek basin is within the city limits of Bellevue, with small pieces of Newcastle and unincorporated King County included. Much of the lower portion of May Creek basin lies within the city limits of Newcastle, with small portions of Bellevue, Renton, and unincorporated King County included as well. Approximately the upper half of May Creek basin is unincorporated. The lowermost parts of the

Cedar River Basin are mostly within the city limits of Renton, with much of the remaining Cedar River (upstream from about two miles above I-405) in unincorporated King County.

In general, land use in the study area is highly urban in the western portions near Lake Washington and becomes more rural toward the east. The three small Lake Washington drainages lie totally in the western, more urbanized areas. The three larger drainages each show east-to-west urbanizing patterns, though the nature of the rural areas varies between the three streams.

Western Coal Creek basin is a mixed pattern of highly urbanized areas near downtown Bellevue and extensive parkland in the canyon of Coal Creek and tributary streams. To the east, the upper basin is mainly forested regional parks and golf course, with interspersed areas of dense suburban development and some areas of resource extraction (gravel mining and rock quarries).

May Creek basin also exhibits a mixed pattern. Dense suburban and commercial areas dominate the western end near downtown Newcastle, while the upper reaches of May Creek have areas of remnant agricultural lands, more areas of suburban development, and some areas of golf course, forested parkland, and resource extraction.

The Cedar River portions of the study area display a greater range of land use patterns. The lower Cedar includes heavy industry (Boeing's Renton plant and related facilities), an airport, downtown Renton, and older residential areas. More recent suburban development covers much of the slopes upstream from I-405, with small areas of park and protected open space in the side-canyons of tributary streams. In the main Cedar River valley many areas still are in agricultural land uses, and plateau areas away from the river have a mix of suburban development and forestry.

3. Local Coordination

An important part of the watershed characterization efforts is coordination with local and regional governmental entities and watershed groups. Our reasons for doing this are:

- To coordinate our actions with local watershed planning groups and other local, tribal, and regional governments
- To exchange data with these same groups
- To gain insight into local watershed recovery themes
- To collect published and unpublished material related to conditions in the study area
- To acquire a priority list of locally-developed restoration sites

We begin our local coordination efforts with preliminary meetings with local groups. We try to keep lines of communication open with these groups as we complete our watershed characterization. During this period, we pursue as much data sharing as we can. We also gather and review locally produced studies, plans, and other documents (watershed plans, limiting factors analyses, etc.).

During the watershed characterization for North Renton, we met with a variety of groups with interests in the study area. Attendees at these preliminary coordination meetings included representatives of a wide variety of groups and governmental entities. Some of the key early meetings are listed here:

- April 30, 2003: Met with Muckleshoot Tribe natural resource staff

- May 21: Met with Northwest Indian Fisheries Commission natural resource and GIS staff
- June 11: Met with WRIA 8 staff from King County
- July 16: Addressed Interstate 405 Environmental Steering Committee
- July 24: Addressed Interstate 405 Executive Committee in Bellevue
- July 29: Met with engineering and natural resource staff of cities in North Renton corridor (Bellevue, Renton, Newcastle)

We continued to communicate with these groups in several ways. Individuals or small groups of staff from the Washington State Department of Transportation (WSDOT) met with technical counterparts in the local entities to get background information, discuss data needs, etc. We sent a series of weekly "status reports" to a wide mailing list of local, regional, and tribal staff and others, detailing our progress and communicating data needs, etc. And we held a "debriefing" meeting, inviting the entire status report mailing list, when the main watershed characterization work was completed in November.

We also communicated with staff from state resource agencies including the Washington Department of Fish and Wildlife (DFW) and Washington Department of Ecology (Ecology).

Data sharing is integral to our work. One facet was working with GIS staff to use existing locally-derived data sources where possible, and to assure that when we developed our own data sources we used standards that would make the data useful to the local groups. Additionally, we shared unpublished reports from various groups as well as white papers and field reports developed during our study, and early versions of the study results.

We consulted draft and completed reports containing watershed priorities for habitat restoration, salmonid recovery, water quantity and base flow improvements, and water quality improvements. Besides containing much valuable background, these were "mined" for lists of local restoration priorities. Later in the watershed characterization process, we matched these lists to our own mitigation site lists, affording higher priority to sites which were also local priorities.

Most of the material developed during this phase is reported in the appropriate parts of this report. Specifically, the local priority information is discussed below.

4. Local Priorities

We used watershed plans, limiting factors analyses, and other local products that include priorities for ecosystem recovery to catalog and assess locally-determined priority restoration sites. These are one of the priority factors we use when developing our own lists of potential mitigation sites.

For determining local priorities in the study area, we used the following documents to identify local priorities:

- Coal Creek Basin Plan and Draft Environmental Impact Statement (King County Dept. of Natural Resources, 1986)
- Lower Cedar River Basin and Nonpoint Pollution Action Plan (King County Dept. of Natural Resources, 1997)

- Salmon and Steelhead Habitat Limiting Factors Report for the Cedar – Sammamish Basin, Water Resource Inventory Area 8 (Kerwin, J. 2001)
- May Creek Basin Action Plan (King County Dept. of Natural Resources, 2001)
- Near-Term Action Agenda for Salmon Habitat Conservation, Lake Washington/Cedar/Sammamish Watershed, WRIA 8 (King County, 2002)

Each of these documents contains a list of locally-defined proposed projects for water quality enhancement, runoff control, ecosystem recovery, salmon recovery, sediment control, flood amelioration, or similar benefits. Some proposed projects – such as pure flood-control projects – were less useful than others. Due to the age of some of the plans (especially the Coal Creek Basin Plan), some of the projects have already been completed.

We also consulted with the Mid-Sound Fisheries Enhancement Task Force, however, they are not working in the study area yet and had no priorities to report (personal communication, Fiona McNair, Mid-Puget Sound Fisheries Enhancement Group).

We scoured the documents for project proposals that might be useful to our effort. Such projects were proposed actions that would be located in our study area, that might be used to mitigate impacts of the I-405 project, and that had not already been completed (to the best of our ability to determine). We created a list of all the appropriate locally-defined proposed projects and mapped these sites. We identified sites in the Cedar River basin, May Creek basin, and Coal Creek basin. We did not identify any locally-defined proposed projects in the three Lake Washington drainage basins. For a map of the locally-defined proposed project sites, see Figure 1.

GIS analysis of these sites allowed us to find locally-defined proposed projects which are close matches to sites we had identified using watershed characterization. Exact correlation wasn't always possible due to the lack of detail in the maps published in the plans. We found 20 sites that appear to be proposing actions which are similar to actions we propose based on watershed characterization. These "overlapping" sites are listed in Appendix D.

5. Scales of Analysis and Mitigation

To complete watershed characterization, it is essential to first establish appropriate scales of analysis and mitigation. In this step, we define the area of potential impacts of a transportation project and establish a series of temporal and nested spatial scales. Within these scales, we assess project impacts and identify mitigation opportunities. Below, we define and describe each spatial and temporal scale used in this characterization effort. Gersib et al. (2004) presents standardized methods used to establish each scale.

Spatial Scales of Analysis

Watershed characterization methods are based, in part, on the principle that different things can be learned and understood by assessing different spatial and temporal scales. Here we define the spatial and temporal scales used to characterize and describe natural resource conditions.

Project Area: The limits of construction for a transportation project. We established the project area based on engineering drawings showing the anticipated limits of construction. We assume that all direct project impacts to natural resources will occur within the project area. The project area for the I-405 North Renton project is shown in Figure 2.

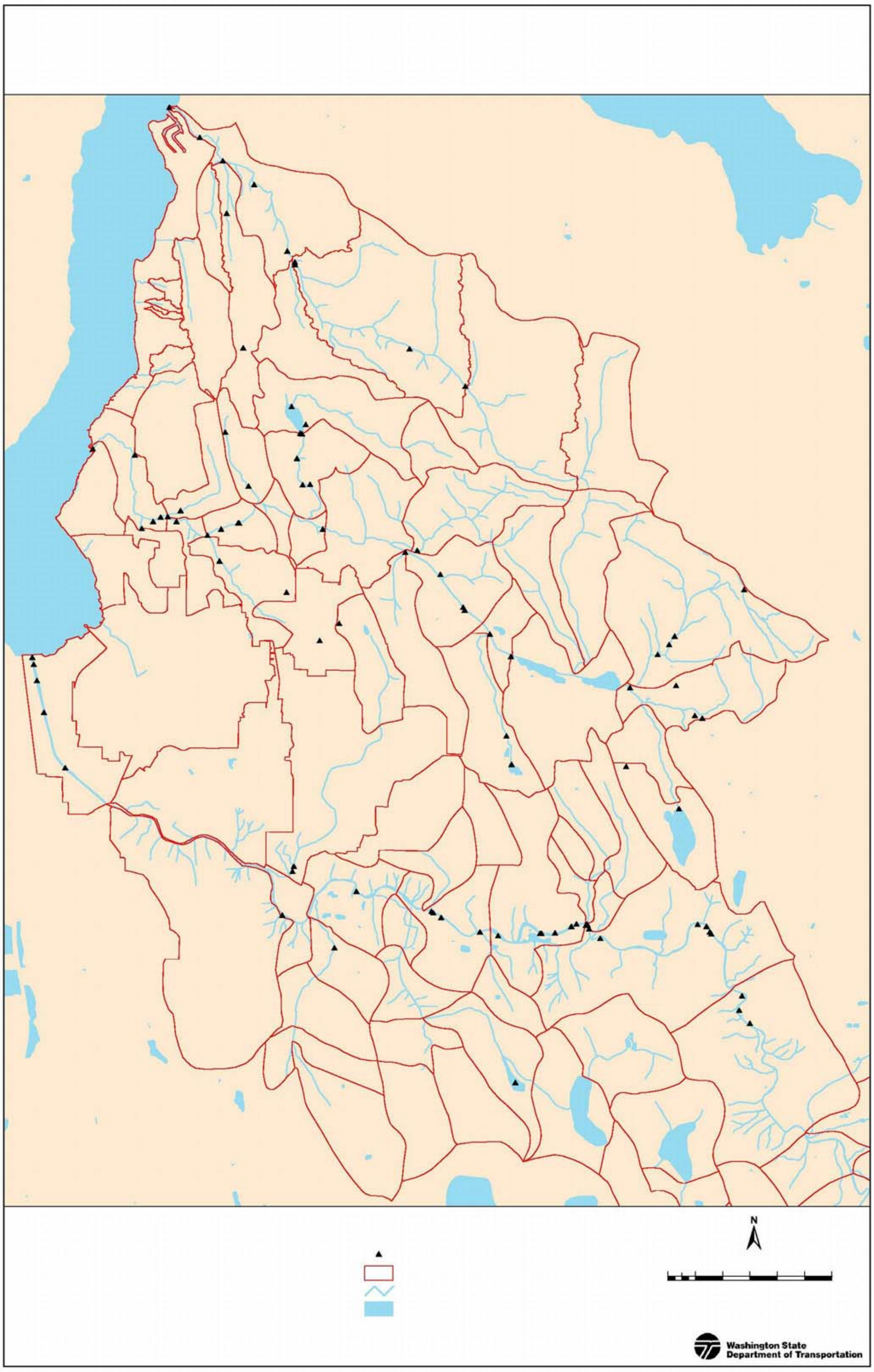


Figure 1: Locally-Defined Proposed Project Sites

Study Area: The largest scale of analysis. The study area includes the project area, the area down-slope of the project area to Lake Washington, and an up-slope area that includes all of the May and Coal Creek watersheds and the Cedar River watershed up to approximately State Route 18. The study area for the I-405 North Renton project is shown in Figure 3.

Drainage Analysis Unit (DAU): **A surface catchment of approximately 200 to 2000 acres that drains to an individual stream system within the study area.** This area unit is the fundamental spatial unit used to assess and quantify direct impacts of the transportation project and characterize cumulative effects of the project and surrounding land use. We subdivided the study area into 119 DAUs as shown in Figure 4.

Mitigation Area: Sub-divisions of the study area, established to organize mitigation needs and opportunities. We establish mitigation areas based on local, state, and federal regulatory guidelines used for directing the mitigation of stormwater and natural resource impacts of the project. We subdivided the study area for the I-405 North Renton project into six mitigation areas shown in Figure 5.

Temporal Scales of Mitigation

Project impact assessment requires only an understanding of the transportation project and the location and current state of the natural resources that will be impacted. Cumulative impact assessment, and assessment of water quality loading rates under a build-out scenario, require multiple temporal scales. To assess cumulative impacts and the project's contribution to them, we need pre-development and current land use conditions. Current and future build-out conditions allow us to understand potential future cumulative impacts in a build-out scenario. They also allow us to assess the potential of the candidate mitigation sites to maintain functions over time. Without an understanding of the pre-development and future build-out conditions and results of associated analyses, we believe subjectivity is increased when identifying and prioritizing mitigation sites having the greatest potential to maximize environmental benefit and minimize mitigation cost.

Pre-development Land Cover Condition

Pre-development Land Cover Condition is a data layer which is the reference point for assessing the current and future state of natural resources within the project area. An assessment of landscape condition requires an understanding of the extent of change in ecological processes from a pre-development to present and future land use conditions. For the purpose of our analysis, we assume the entire I-405 North Renton study area was in a forested land cover condition prior to European settlement.

Current Land Cover Condition

Current Land Cover Condition is a data layer showing existing conditions in the study area. We use current land cover data to compare current conditions with pre-development land cover, in order to gain perspective on the extent of change in land cover over time. We also use current land cover data to calculate key landscape attributes needed to characterize the extent of alteration in ecological processes. In our watershed characterization, we used a current land cover dataset developed by King County in 2001 using remote sensing data. Figure 6 presents this information.

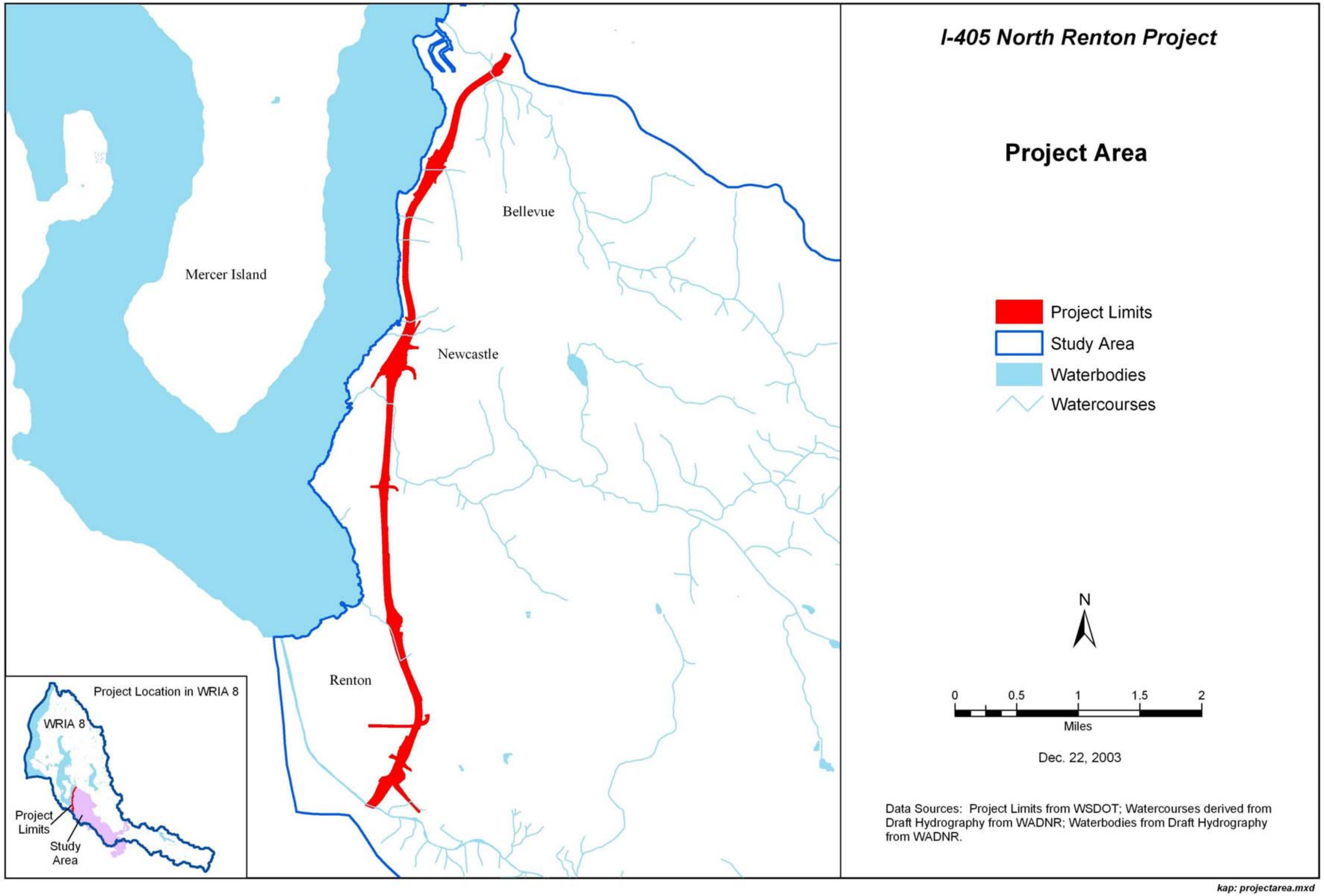


Figure 2: Project Area for the I-405 North Renton Project

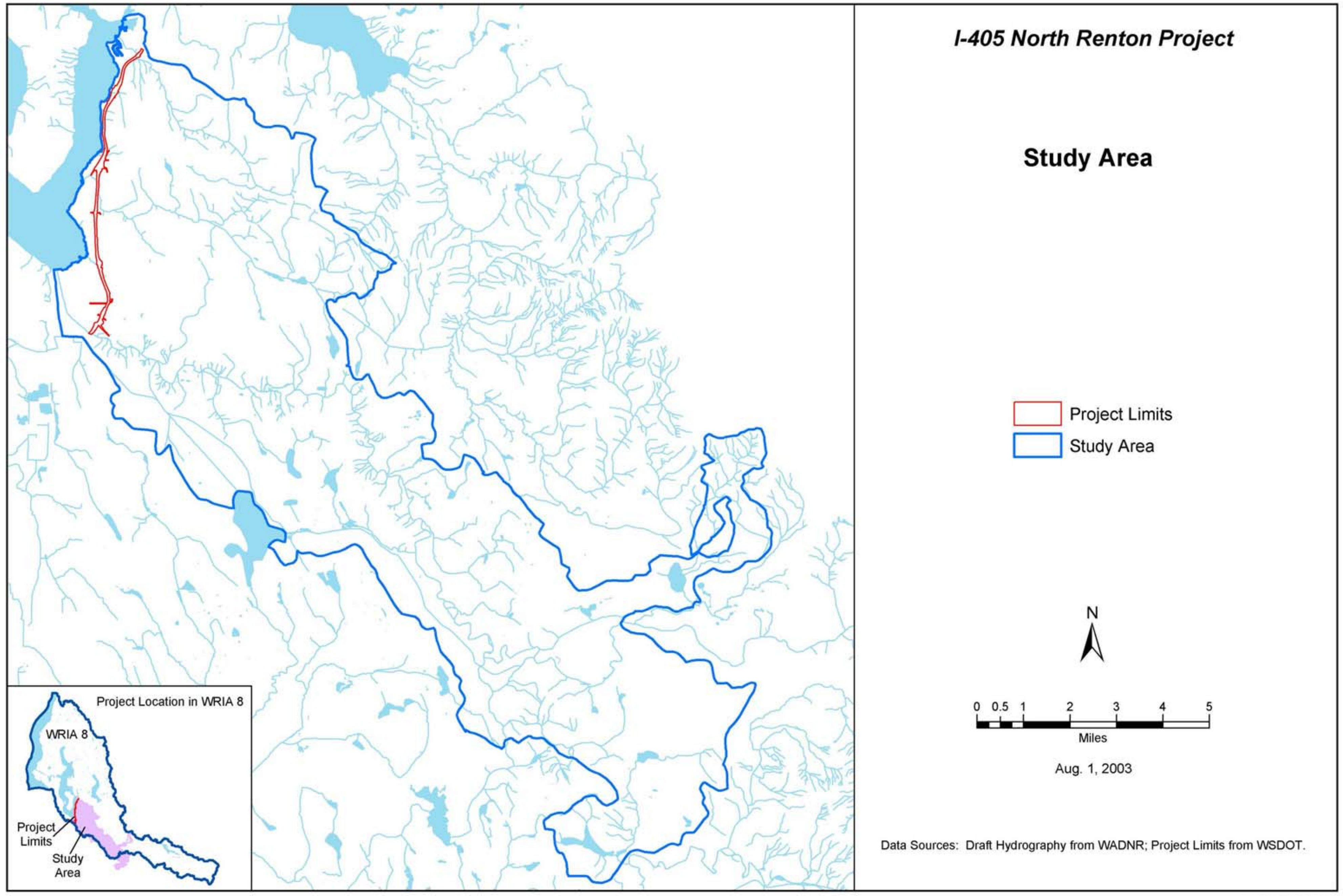


Figure 3: Study Area for the I-405 North Renton Project

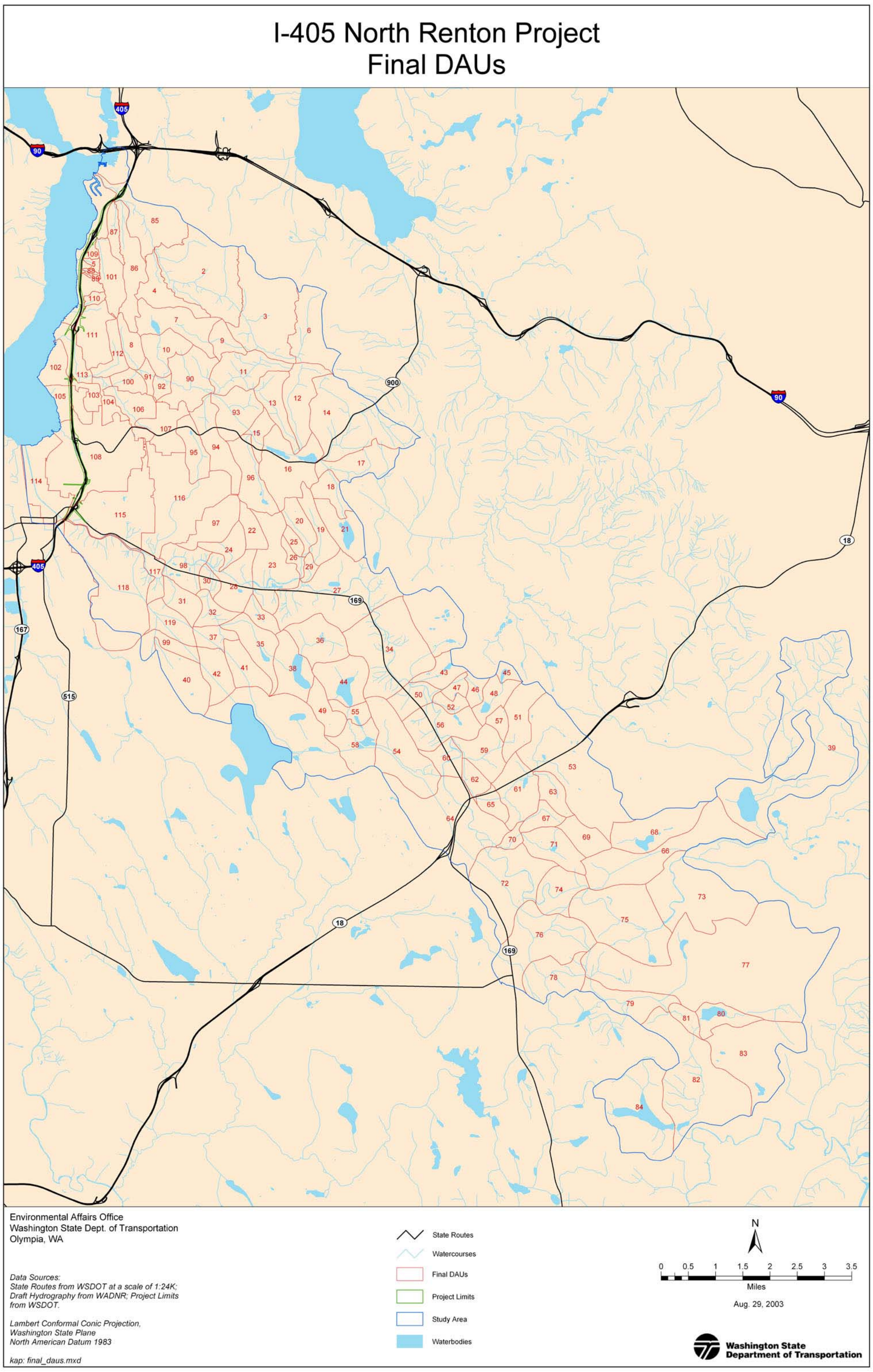


Figure 4: Drainage Analysis Units for the I-405 North Renton Project

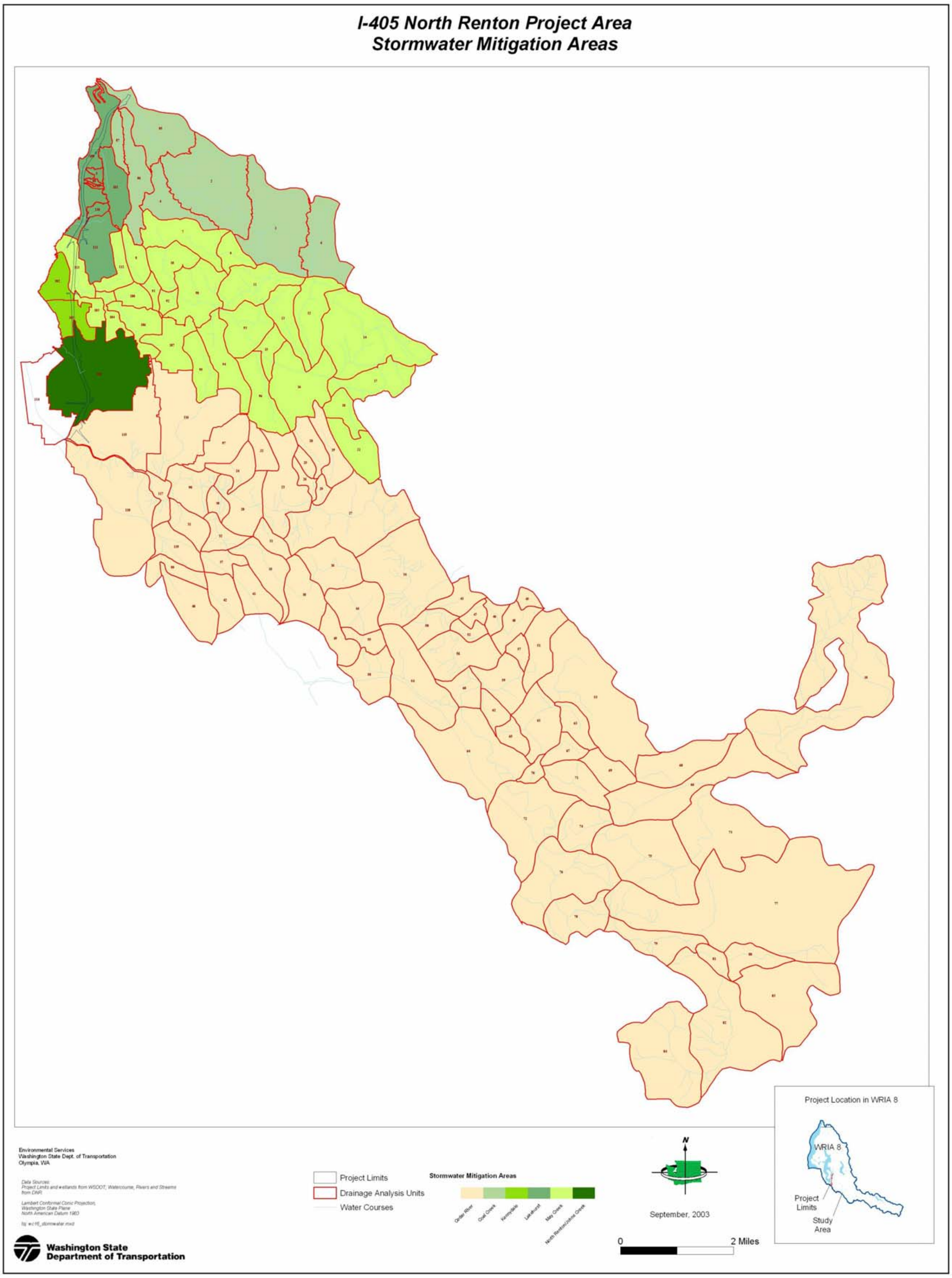


Figure 5: Six Mitigation Areas for the I-405 North Renton Project

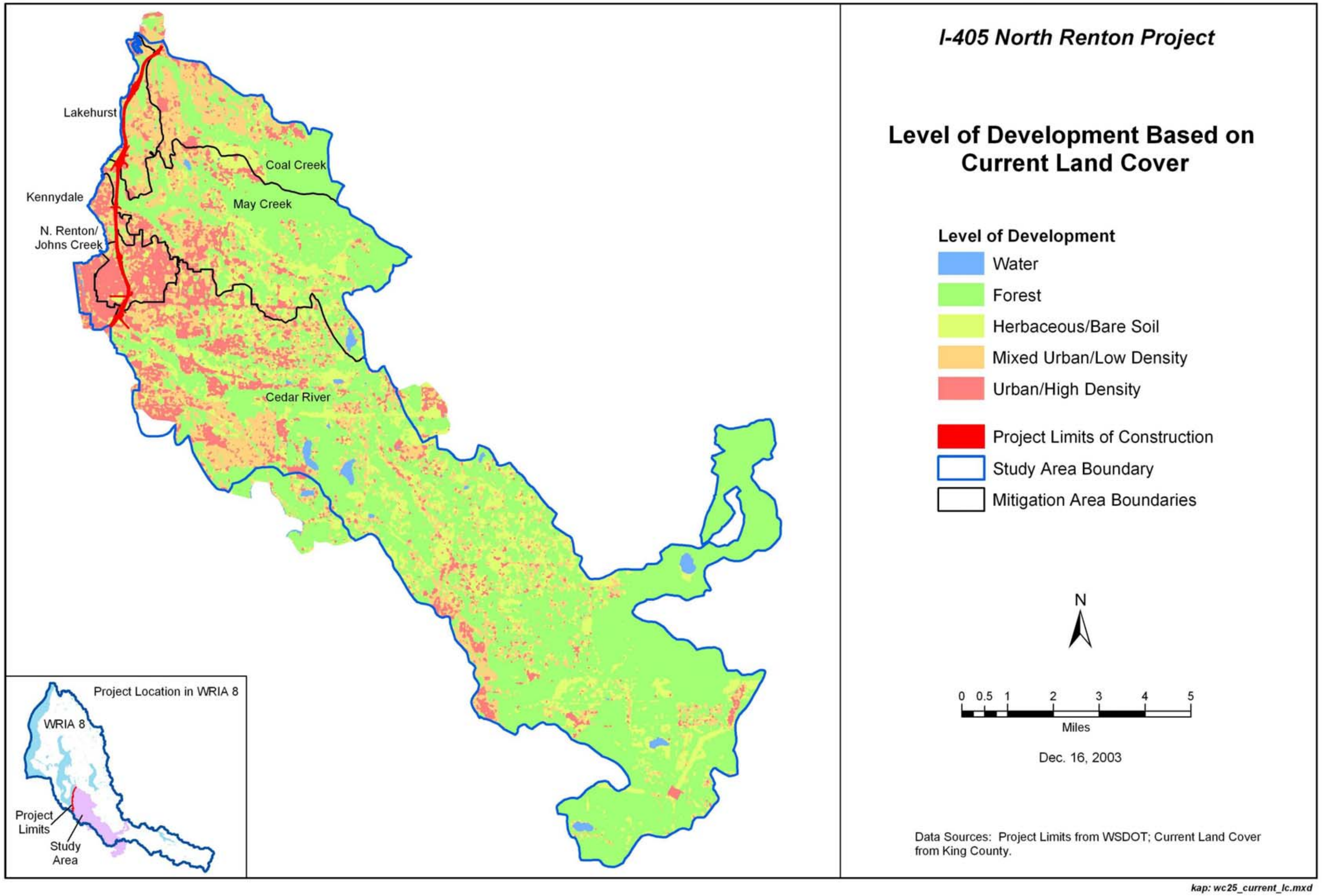


Figure 6: Level of Development Based on Current Land Cover

Future Land Cover Condition

Future Land Cover Condition is a data layer showing predicted future conditions in the study area. Conventional methods for identifying and assessing potential mitigation sites primarily focus on assessing a site's ability to mitigate project impacts under current conditions. We additionally seek to understand the future development pressures that will influence a site's ability to maintain environment functions. Surrounding land use influences how a site functions. This approach helps resource managers gain a better understanding of a mitigation site's potential to mitigate project impacts and maintain environmental function over the long-term. We assume that resource impacts are permanent. Mitigation sites must be screened to ensure they have the greatest potential to replace and maintain functions over the long-term.

We developed future land cover from a combination of digital coverages. These include King County comprehensive plans, and city comprehensive plans from Bellevue, Newport, and Renton. In Urban Growth Areas we used the city comprehensive plans; outside Urban Growth Areas we used King County's plan. Classification codes and descriptions differ for land use classes in the different jurisdictions. We developed a common classification scheme, by analyzing the four comprehensive plans and assigning each land use class into a slightly broader generic class. We then assigned a total impervious area (TIA) percent to each of those generic classes. Projected future land use is shown in Figure 7.

6. Characterize Condition of Key Ecological Process Drivers

Understanding natural resources, and the ecological process drivers that create and maintain them, is the foundation of this watershed characterization work. This understanding establishes the landscape context from which to identify and prioritize potential mitigation options. To establish this context, information was compiled on the location, extent, and condition of wetland, riparian, and floodplain resources, condition of fish and wildlife habitats, and the effects of human land use on surface and subsurface flow of water within the study area. To gain understanding, this information was compiled by individual team members and then presented to the interdisciplinary technical team. The following summarizes our findings.

Understanding natural resources – and the ecological process drivers that create and maintain them – is the foundation of this watershed characterization work.

Geology

Interactions between precipitation, vegetation, soils, and geology govern the movement of water through natural landscapes. A key step in watershed characterization is to understand how these factors influence the routing and delivery of water, so we can identify mitigation alternatives that restore natural flow conditions.

Figure 8 depicts the surficial geology within the study area. Uplifted marine sedimentary and volcanic rocks are exposed in the Newport Hills. Glacial till, made up of soil and rock compacted by ice, covers the upland plateaus. Till is almost impermeable to water, and forms a layer of hardpan that blocks infiltration. Runoff from till soils usually occurs as shallow subsurface flow.

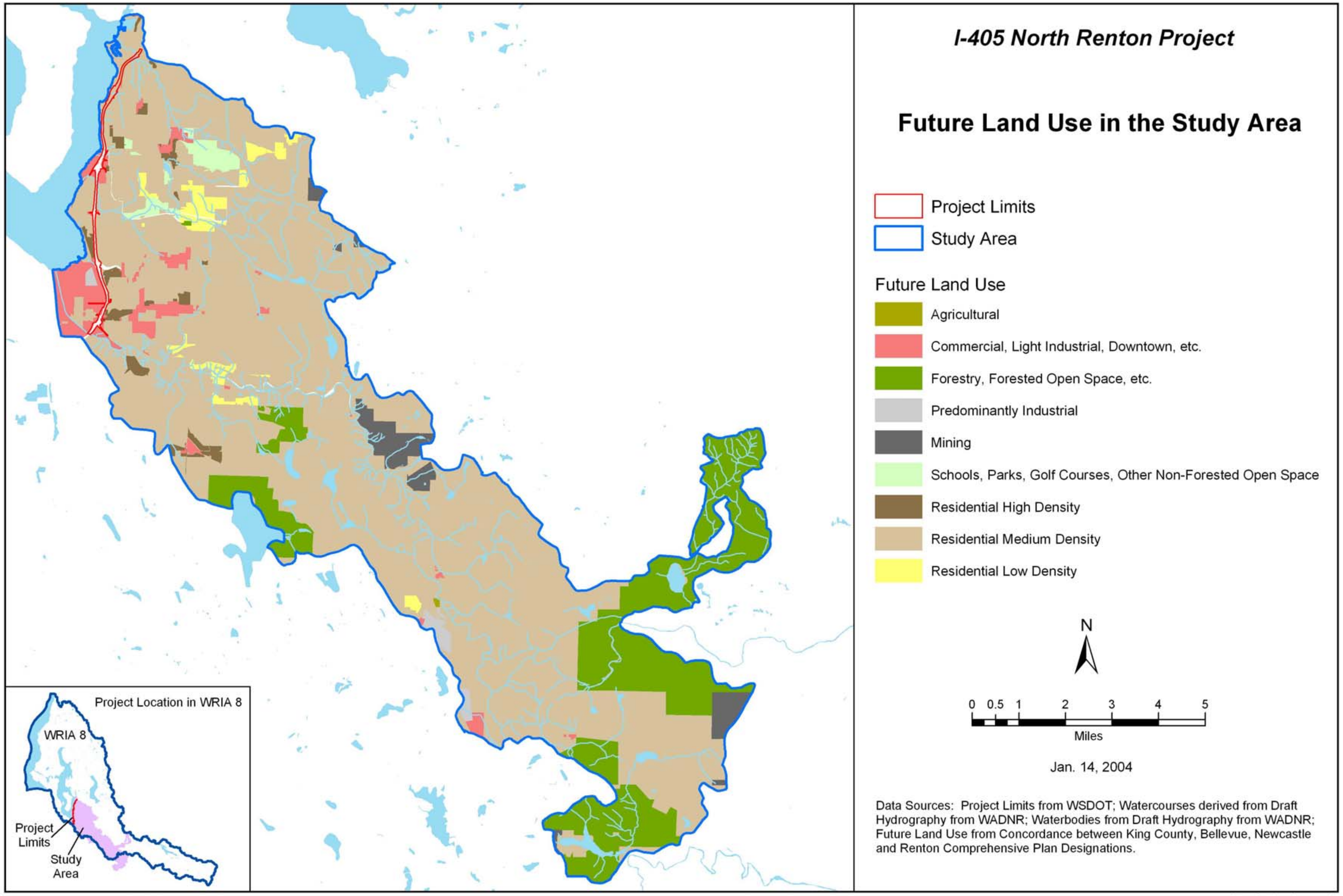


Figure 7: Projected Future Land Use

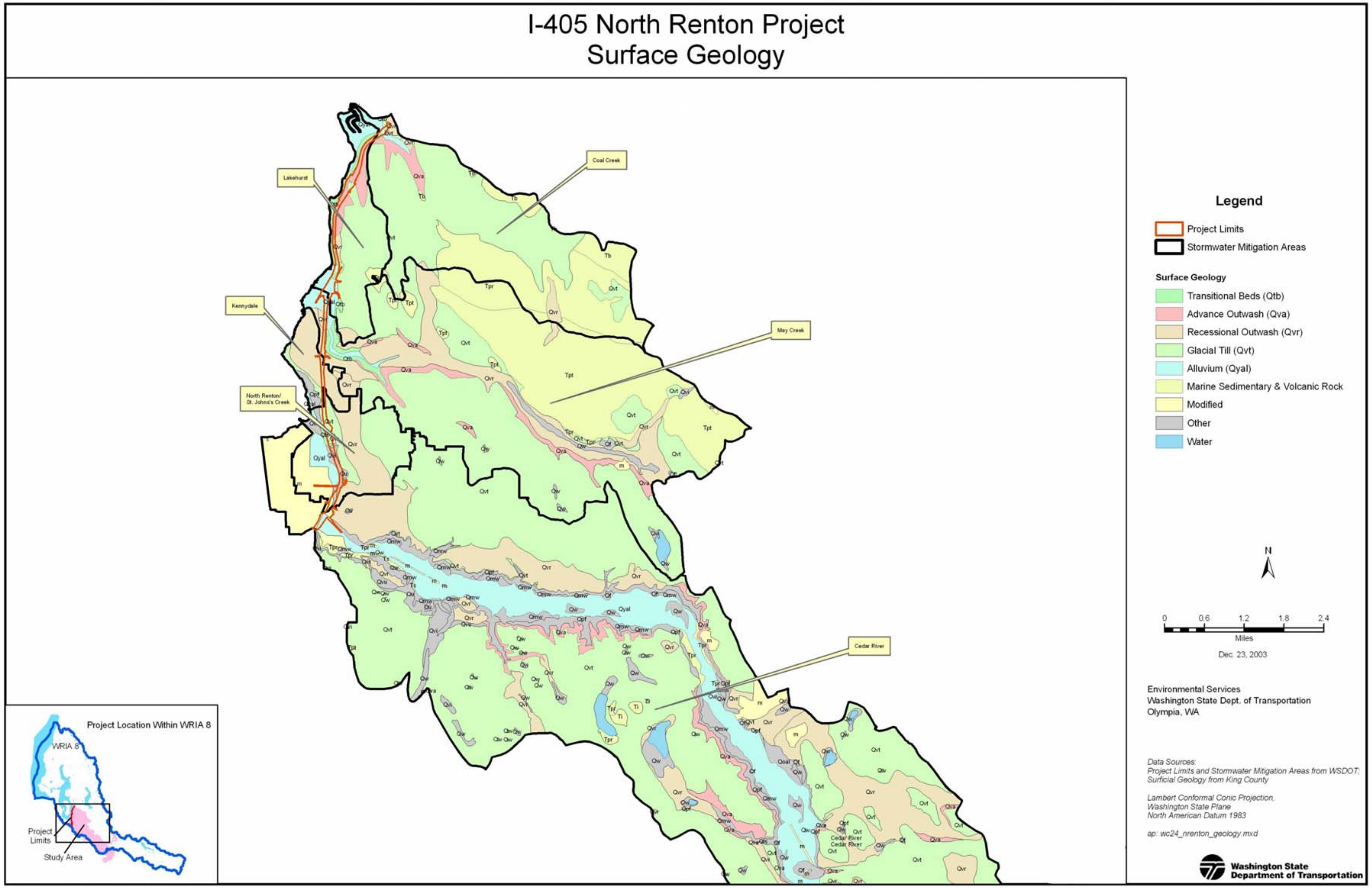


Figure 8: Surficial Geology Within the Study Area

Outwash deposits, found in old glacial meltwater channels, are composed of coarse sands, gravels, and cobbles. Advance outwash, deposited as glaciers advanced, is exposed where hill slopes or stream valleys cut through the overlying till. Recessional outwash, deposited as glaciers receded, lies on top of glacial till, and is found in the May Valley and on terraces in the Cedar River valley. Outwash soils have rapid infiltration rates and usually produce very little runoff. However, outwash soils in low-lying areas may produce rapid overland runoff during storms when the groundwater table rises to the surface.

The Cedar River has cut a broad valley and steep bluffs into the glacial plains, and has reworked glacial materials on the valley floor. The floodplain is covered with alluvial silts, gravels, and cobbles.

Although till covers most of the study area, groundwater recharge is most rapid where coarse recessional outwash is exposed at the surface. Recharge rates are lowest in developed areas where pavement and soil compaction have reduced soil infiltration rates. In the Cedar River basin development has decreased groundwater recharge rates by five to ten percent (Metropolitan King County Council, 1997).

Alluvial deposits at the mouth of the Cedar River form the most productive aquifer in the area, providing over 6.5 million gallons per day for the City of Renton. The water table lies within 23 feet of the ground surface in some areas, and is closely related to water levels in the Cedar River. The Cedar River aquifer is a sole source aquifer, and the City of Renton has designated special aquifer protection zones to protect water quality in this important resource (Figure 9, showing aquifer protection zones). No stormwater infiltration is allowed in Zone 1. In Zone 2 stormwater must be treated for water quality before infiltration.

For more detail on the study area geology, see Appendix J.

Advance outwash deposits often contain groundwater that is partially confined by till. This groundwater is an important water source for wetlands and streams like May and Coal Creek that intercept advance outwash deposits. Small lenses of groundwater may also be found in till deposits, and are occasionally tapped for domestic wells in rural areas.

Surface Water Resources

This section discusses surface water resources, including water quantity and water quality. Within this section, we used these sources for water quality data for the project drainages:

- Ecology’s 1998 303(d) list of Impaired and Threatened Waterbodies
- Ecology’s EIM database
- The Current and Future Conditions reports for May Creek (Foster Wheeler Corporation, 1995) and the Cedar River (King County Department of Public Works, 1993)
- King County’s Streams Monitoring Program website (http://dnr.metrokc.gov/wlr/waterres/streams).

Coal Creek drains 4,220 acres of land that extends from the slopes of Cougar Mountain down to the shores of Lake Washington (see Figure 10, showing drainage basins and soils). Till soils with high runoff potential (C/D soils) cover more than 95 percent of the basin. Impervious surfaces cover 21 percent of the basin.

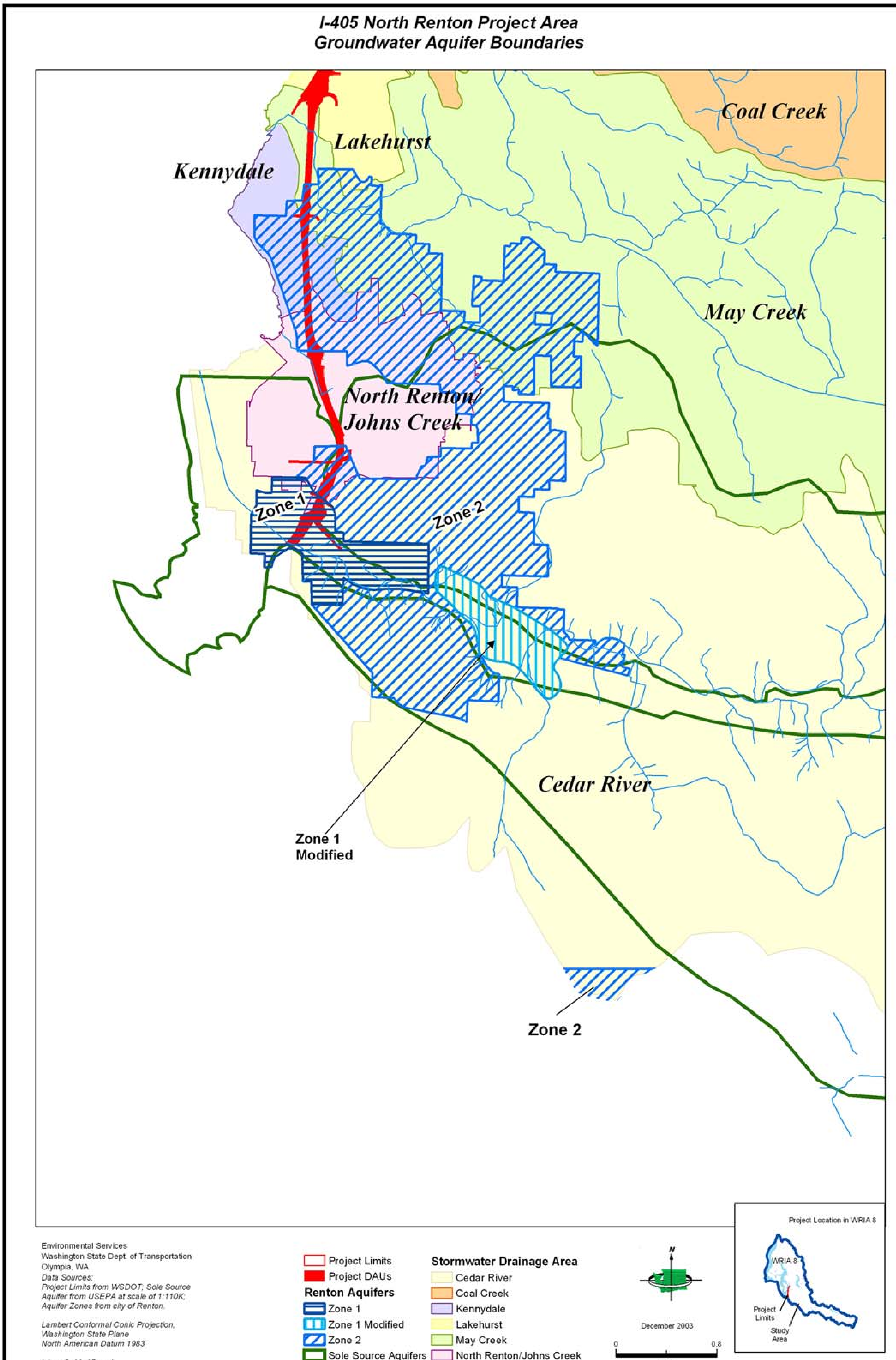


Figure 9: Aquifer Protection Zones

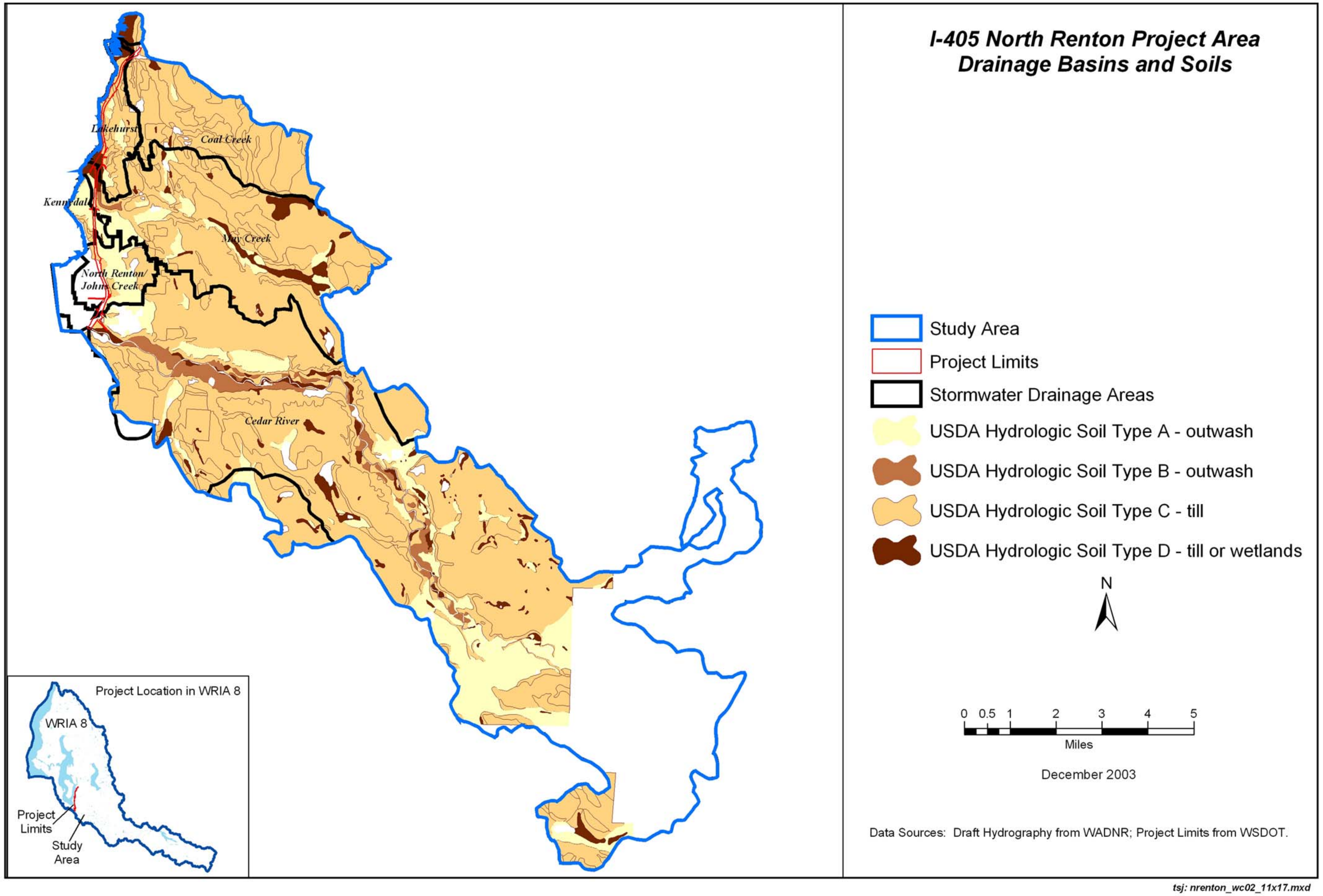


Figure 10: Drainage Basins and Soils

Coal Creek drops rapidly through sequences of bedrock, till, and advance outwash. Historical coal mining has radically altered surface water/groundwater interactions in the upper watershed. The South Fork tributary originates from an extensive mine drainage system. In the lower section of the valley the creek intercepts and is probably fed by groundwater contained in advance outwash.

Table 1 lists peak flow estimates for Coal Creek near I-405. Between 80 and 90 percent of the peak flow is generated above Coal Creek Parkway, where steep slopes, thin till soils, and high precipitation combine to produce high runoff rates. At Newcastle Road the creek drains areas protected by Cougar Mountain Regional Park, and peak flows are about 20 to 30 percent of the peak flow at I-405.

The priority stormwater issue in the basin is sediment control. Because of limited opportunities for detention and sedimentation ponds, existing facilities trap only a small percentage of the annual sediment load. Consequently, local governments focus their efforts on channel stabilization and bioengineering of steep slopes. The City of Bellevue operates detention and sedimentation ponds in Coal Creek upstream of I-405 and Coal Creek Parkway.

The Coal Creek Basin Plan (City of Bellevue and King County, Washington, 1987) predates the incorporation of the City of Newcastle. Less than 20 percent of Newcastle drains into the Coal Creek basin. The city operates no major stormwater treatment facilities in the basin, although there are facilities that serve private developments.

For more detail on the study area hydrology, see Appendix J.

Sediment is the major water quality issue in Coal Creek. Stormwater runoff erodes stream channels and clogs the streambed with fine sediment. Historical coal mining channelized sections of the headwater streams and dumped mine tailings along streambanks. Erosion control problems during construction of the Newcastle Hills Golf Course sent large sediment loads into Coal Creek and Lake Boren. Sedimentation has enlarged the delta at the mouth of the creek, causing flooding and navigation problems (City of Bellevue and King County, 1987).

King County's Streams Monitoring Program has found high levels of turbidity and suspended solids in Coal Creek. Water temperatures are generally low and dissolved oxygen levels are higher than average for King County streams. Metals in stormwater samples collected between 1997 and 2002 did not exceed state criteria. Conductivity and pH are high, due to mining impacts and the geochemical characteristics of the sandstone bedrock in the upper watershed. Nutrient concentrations are near or below average for streams in King County's monitoring program. Coal Creek is on Ecology's 1998 303(d) list for fecal coliform.

Buchanan (2003) observed a distinct change in visual sediment and water quality downstream of a left bank tributary stream that originates from an abandoned mineshaft. The tributary discharged discolored water into Coal Creek, and left a bright orange precipitate crust on streambed materials. The effects of this discharge could be seen in Coal Creek below I-405, where gravels were coated with algae and supported few aquatic insects.

May Creek drains a basin of 8,950 acres. Till soils cover 80 percent of the total basin area. Outwash soils (A/B soils) are found in the May Valley, on terraces along the lower creek canyon, and in the southwestern portion of the basin. Impervious surfaces cover 18 percent of the basin.

The headwaters of May Creek originate in the Newcastle Hills, but quickly drop down into May Valley near State Route 900. A natural rock sill near 148th Avenue SE controls the gradient of the valley, which is filled in with wetland deposits and alluvium that cover recessional outwash. During the winter, groundwater collects in the May Valley and combines with stream runoff to feed extensive wetlands and lowland flooding. Below 148th Avenue SE the creek drops into a steep canyon that cuts through Vashon advance outwash deposits. Groundwater from this outwash probably flows into the creek and provides a source of summer baseflow.

Table 1 lists peak flow statistics for May Creek. Boren Creek, Honey Creek, and the North Fork are the largest tributaries. May Valley attenuates and stores runoff, decreasing peak flows that enter lower May Creek Canyon. Peak flows at the head of May Creek Canyon (above Coal Creek Parkway) are 60 to 70 percent of the total at I-405.

Because of the low gradient and large storage capacity, flooding in May Valley depends more on the seasonal volume of runoff than on peak flow rates. Increased runoff rates from low-density development in the East Renton Plateau and Highlands area exacerbate the flooding problem. Detention of runoff from these areas is not likely to solve flooding issues in the May Valley, since these measures delay but do not reduce runoff volumes.

The City of Newcastle covers most of the Boren, Newport Hills, and Gypsy Creek basins. The City of Renton covers the lower portion of the watershed, including most of the Honey Creek subbasin. Much of the Honey Creek drainage area was developed before modern stormwater standards were adopted, and has opportunities to improve stormwater management and reduce downstream erosion problems.

Sediment is also a problem in May Creek. Sediment from the Highlands and East Renton Plateau is deposited in the May Valley, reducing the capacity of the channel and damaging fish habitat. Stormwater runoff also causes channel downcutting and bank erosion in May Creek Canyon, Newport Hills Creek, Gypsy Creek, and Honey Creek. An average of 2,000 cubic yards of sediment per year is dredged from the mouth of May Creek (King County and City of Renton, 2001).

Fecal coliform levels in May Creek exceed standards for water contact activities during storm events. Summer water temperatures are high in upper May Valley. Phosphorus levels exceed Environmental Protection Agency guidelines, but total phosphorus loadings are small relative to other Lake Washington tributaries (Foster Wheeler Corporation, 1995). The Honey Creek tributary is a major source of metals contamination. May Creek is on the 1998 303(d) list for fecal coliform, temperature, copper, lead, and zinc. However, metals data collected by King County since 1997 have not shown any exceedances of state criteria.

The Cedar River drains a basin of 184 square miles at the United State Geological Survey stream gage in Renton, including 62 square miles within the project study area. The upper 122 square miles drain into the City of Seattle's reservoirs and Landsburg diversion. Seattle diverts an average of about 190 cubic feet per second (cfs) from the river for water supply (King County Department of Public Works, 1993).

The Cedar River has cut deeply into the adjacent drift plains, creating steep bluffs that expose layers of glacial material. Springs often emerge where the bluffs intersect coarse glacial deposits. Glacial till soils predominate on the plateaus that lie above the bluffs. Runoff from these plateaus is typically conveyed to the Cedar River through the canyons of tributary creeks that have eroded into the steep valley walls. Glacial outwash terraces line the margins of the valley floor, and infiltrate much of the runoff from adjacent hill slopes.

Table 1 summarizes peak flow statistics at Renton. Because of the low level of development in much of the upper watershed, existing peak flows are only about seven percent higher than would occur under forested conditions. Future development is projected to increase flood flows by another eight percent. Taylor Creek and Madsen Creek are the largest tributaries, followed by Peterson Creek, Fairwood/Molasses Creek, and Rock Creek.

Flood flows in the Cedar River are mostly generated from the upper watershed. The Masonry Dam stores floodwaters and decreases the 100-year peak flow at Renton by 30 percent. Local runoff from Renton peaks during the early part of storms, and shows up in the rising limb of Cedar River flood hydrographs. The Lower Cedar River Basin and Nonpoint Pollution Action Plan (Metropolitan King County Council, 1997) concluded that detention of runoff from areas discharging directly to the lower 17 miles of river has little impact on flood peaks and flow durations.

Under natural conditions, wetlands, remnant channels, and floodplain forests stored and attenuated overbank flows and stormwater runoff. Many of these features have been filled, drained, or otherwise altered to facilitate other land uses. The Lower Cedar River Basin and Nonpoint Pollution Action Plan, therefore, focuses on strategic removal of floodplain fill and levees to restore natural storage functions and removal of structures from frequently flooded areas.

The Cedar River is the largest source of clean water for Lake Washington. The lower Cedar River generally has good water quality, but has exceeded standards for turbidity and fecal coliform during storm events. The Cedar River is on the 1998 303(d) list for fecal coliform. Sources of water quality problems along the lower mainstem include commercial and industrial areas in Renton, roads, and airport facilities. Storm sampling conducted by King County in 1991 found high levels of metals in samples collected from the Logan Street outfall, I-405 stormwater outfalls, and in a ditch that drains the Boeing and City of Renton airports.

Small noncommercial farms and failing septic systems are major sources of nutrients and fecal coliform, particularly in the Taylor Creek subbasin (King County Department of Public Works, 1993). Residential developments in the Fairwood, Ginger Creek, Maplewood, and Madsen basins are the largest source of total suspended solids, total phosphorus, and lead. Future development is projected to increase pollutant loadings by 39 percent for TSS, 63 percent for total phosphorus, 103 percent for lead, and 32 percent for fecal coliform (King County Department of Public Works, 1993).

The **Lake Washington drainages (**Lakehurst, North Renton / Johns Creek, and Kennydale) cover much of the land adjacent to I-405 in the study area. These areas drain directly to Lake Washington through urban storm drains and remnant stream channels.

The Lakehurst area drains 1,300 acres between May Creek and Coal Creek, and lies mostly within the City of Bellevue. Till soils with high runoff potential underlie 78 percent of the area, and 31 percent of the land cover is impervious. Geologic maps show bands of outwash deposits in this area, so the till soils may be relatively thin or they may have been inaccurately mapped by the soil survey.

The Kennydale area drains 440 acres of Lake Washington shoreline south of May Creek. This area is heavily urbanized, with 50 percent covered by impervious surfaces. Recessional outwash soils with high infiltration rates underlie most of the basin.

The North Renton / Johns Creek area covers 1,370 acres north of the Cedar River, and drains through underground storm drains into a remnant section of Johns Creek before entering Lake Washington. Impervious surfaces cover 60 percent of the basin area. Alluvial and till soils with moderate to high runoff potential underlie most of the area. A terrace of recessional outwash soil crosses the northern portion of the basin upslope of I-405.

The Lake Washington drainages do not have noted specific water quality problems.

Table 1: Peak Flow Estimates for Study Area Drainages

Stream	**Peak flow at I-405 (cfs)**					
	2-year	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**
Coal Creek [1]						
Future Buildout	269		387	448		542
May Creek[2]						
Forested Land Cover	223			480		636
Existing	341			670		835
Future Buildout	391			840		1059
Cedar River[3]						
Forested Land Cover	3500	4700	5800	8000	9700	11000
Existing	3700	4900	6100			
Future Buildout	4000	5200	6400			

[1]Northwest Hydraulic Consultants, Inc. 1997. Updates to HSPF simulations from the 1987 Basin Plan to reflect constructed detention basins and preservation of forest in Cougar Mountain Regional Park. Historical and existing condition simulations were not performed.

[2]King County and the City of Renton, 1995. May Creek Current and Future Conditions Report, HSPF modeling.

[3]King County Department of Public Works, 1993. Cedar River Current and Future Conditions Report, HSPF modeling.

Wetlands

Wetlands are considered to be a key ecological process driver because of their potential to influence the delivery and routing of water, sediments, pollutants, and heat. Identifying the location, extent, and condition of wetlands within the study area provides valuable insight into a landscape's capacity to maintain ecological processes that influence water quality, water quantity, and fish and wildlife habitats. Existing, degraded, and destroyed wetlands also serve as the pool of potential mitigation sites for project impacts to wetlands.

We compiled available wetland data and converted it into an ArcView shape file. Wetland data sources used include U.S. Fish and Wildlife Service National Wetlands Inventory, Washington Department of Natural Resources (DNR) 1:24,000 hydrography, Washington Department of Fish and Wildlife Priority Habitat and Species, hydric soils data from DNR originally developed by the U.S. Department of Agriculture, King County wetlands coverage, and wetland data from David Evans and Associates. Additional wetland information from the Cedar River Current and Future Conditions Report (King County Department of Public Works 1993) and the May Creek Current and Future Conditions Report (Foster Wheeler Environmental Corp. 1995) was extracted and used to supplement available GIS-based data.

Following methods described in Gersib et al. (2004), we interpreted aerial photos of wetland sites and created a GIS database that identifies the location and extent of existing, degraded, and destroyed wetlands with restoration potential. For this analysis, we used 1:12,000 color stereo paired photos and available wetland information. For each potential wetland polygon established, we determined current land use, potential for restoration, hydrologic alteration, vegetative alteration, present hydrogeomorphic wetland class, potential hydrogeomorphic class, and sites with preservation potential. Appendix E explains the potential wetland attribute definitions we used in the analysis. Appendix K presents the wetland restoration site database metadata.

Riparian Areas

Riparian areas are an important natural resource. They influence how water, sediment, nutrients, and large wood are delivered to and routed through a stream system. We identified and assessed the condition of stream riparian areas within a large part of the project study area. This serves as a tool for characterizing key ecological processes, and as a means of identifying potential mitigation opportunities.

We created a riparian GIS theme to identify potential restoration sites within the study area. Available data we used to assess riparian condition include Washington State Department of Natural Resources (DNR) 1:24,000 hydrography, orthophotos taken during the 1990s, and color stereo-paired aerial photos taken in July, August, and September of 2001. We analyzed the entire basins of Coal and May Creeks. We studied the lower Cedar River and associated tributaries from the mouth to river mile 12.3.

We established 33-meter and 67-meter stream buffers using DNR hydrography. The 33-meter buffer provides insight into the condition of the riparian system and its ability to provide stream shading for temperature attenuation and corresponds with local government agencies 100-foot buffer for planning under local critical areas ordinances. The condition of the 67-meter buffer is used to provide an understanding of habitat connectivity, water quality and quantity benefits, and potential for recruiting large woody debris (LWD) and is based roughly on site potential tree height.

Using both orthophotos and color stereo-paired aerial photographs, non-forest areas within the riparian buffers were delineated using GIS. Following methods described in Gersib et al. (2004), we created a polygon and a corresponding database file for each non-forested riparian area. For each polygon established, we determined current land use, potential for riparian restoration, potential to add to an existing forest patch, potential to reconnect two fragmented forest patches, and adjacency to schools and public lands. Appendix K presents the riparian restoration site database metadata.

Floodplains

Floodplain areas represent a mosaic of stream, riparian, and wetland types. They are a third natural resource that influences how water, sediment, nutrients, and large wood are delivered to and routed through a stream system. We identified and assessed the condition of the Cedar River floodplain from the mouth to river mile 12.3. We did this by creating a GIS floodplain theme to gain understanding of overall floodplain condition and to identify potential restoration and mitigation areas.

Available data that we used to assess overall floodplain condition include Washington State Department of Natural Resources (DNR) 1:24,000 hydrography, orthophotos taken during the 1990s, color stereo-paired aerial photos taken in July, August, and September of 2001, FEMA floodplain boundaries, and light detecting and ranging (LIDAR) data.

We identified diked areas that decouple the floodplain from the river and have little or no restoration potential due to development, using the orthophotos, the color stereo-paired aerial photographs, and LIDAR data. Following methods described in Gersib et al. (2004), we created a GIS polygon and a corresponding database file for each floodplain area. For each floodplain polygon established, we determined current land use, potential for restoration, potential to add to an existing forest patch, potential to reconnect two fragmented forest patches, and adjacency to schools and public lands. Appendix K presents the floodplain restoration site database metadata.

Fish and Wildlife Biology

The condition of fish and wildlife and their habitats reflect the condition of ecological processes that create and maintain the structural components of an area. In other parts of this report, we use key landscape attributes to assess the condition of ecological processes. Our purpose in providing a general inventory and assessment of fish and wildlife is to provide further insight into the landscape condition of the study area. While less quantifiable than the percent of non-forest riparian areas in May Creek, the condition of wildlife populations and their habitats provides further perspective into how human-induced change in land cover has affected the study area.

WSDOT biologist Craig Broadhead prepared a report entitled “Fish and Wildlife Inventory and Assessment,” presented in Appendix F. The report summarizes data from selected sources on the location, extent, and condition of fish and wildlife resources.

Key points from the report follow:

Human land use has a profound influence on the number and species of terrestrial wildlife that use the study area. Land use in the study area, as described in other parts of this document, ranges from highly urbanized near Lake Washington to low density residential, parks, and commercial forest to the east. As land use intensity changes, the terrestrial species change to reflect the presence and/or absence of different habitats. For example, urban portions of the study area are inhabited by species typical of that level of development, while different species frequent agricultural areas, and yet others occupy forest habitats.

The highest value terrestrial habitat in the study area occurs within riparian areas and upland vegetated areas that are adjacent to wetlands.

Aquatic resources in the study area support two federally threatened anadromous fish species, Puget Sound Chinook salmon and bull trout, and one federal candidate species, Puget Sound/Strait of Georgia coho salmon.

Over the past 150 years, much of the mainstem aquatic habitat in the lower Cedar River Basin has been dramatically altered by human activities.

Logging, coal mining, and agricultural activities have resulted in channelized streams, floodplain encroachment, and eroded slopes within the May Creek watershed. Expansion of urban and suburban development continues to increase the amount of land clearing and impervious surface in the watershed. Much of lower May Creek watershed is within the designated Urban Growth Area.

Coal Creek's aquatic resources have been altered by historically intensive coal mining and by rapid urbanization in the lower parts of the watershed. Upper parts of Coal Creek are largely preserved in Cougar Mountain Park. Water quality has been degraded by mining and urbanization.

7. Characterize Environmental Conditions

WSDOT wants to target mitigation activities to areas having the greatest potential to benefit from environmental investments. To do this, we seek to understand the landscape-scale condition of aquatic and terrestrial resources and fish and wildlife habitats. Further, understanding the condition of ecological processes establishes a context for assessing mitigation alternatives.

We assessed potential impacts of the transportation project to determine which ecological processes to target for recovery efforts. The most relevant data we used to identify key ecological processes were a) location and extent of potential stormwater, wetland, riparian, and stream impacts within the transportation project limits of construction; and b) the possible loss of functions resulting from resource impacts. The transportation project has potential to affect a number of ecological functions. Our assessment, however, indicates that direct project impact to the delivery of water (increased runoff from new impervious areas) should be considered the primary ecological process to be targeted for recovery at a landscape scale.

> ***The transportation project has potential to effect a number of ecological functions. Our assessment, however, indicates that direct project impact to the delivery of water should be considered the primary ecological process to be targeted for recovery at a landscape scale.***

We present estimated worst-case scenario numbers for stormwater effects and direct project impacts in the site inventory and assessment part of this report. The technical team used best professional judgment to understand the site-specific functions that would be affected under this worst-case scenario. We also assumed that stormwater quality will be treated within the project right-of-way. Based on these assumptions and understandings of site specific functions, we conclude that stormwater impacts associated with increased surface water runoff from impervious areas will dominate the potential impacts in each of the six mitigation areas. In addition, we conducted function assessment work on wetlands and riparian areas within the project limits of construction. This assessment indicates that impacts to these resources would result in additional water-related process impacts associated with the loss of flood storage/desynchronization function.

Based on our function assessment of wetland and riparian systems within the project area, we believe functions not associated with the delivery of water can be adequately mitigated when restoring degraded wetlands or riparian areas that have potential to help restore the natural delivery of water.

We then identified secondary ecological processes to target where opportunities don't exist to target "At Risk" DAUs for the primary ecological process. We base our identification of secondary ecological processes for each mitigation area on direct project impacts and local recovery priorities identified in planning documents for Coal Creek, May Creek, and the Cedar River. We use aquatic integrity as a general measure of habitat condition when anadromous fish habitat or salmon recovery is listed as a local priority. When data are not available to evaluate aquatic integrity using the preferred landscape attribute, Benthic Index of Biological Integrity (Karr and Dudley, 1981), the condition rank for the delivery of LWD was used as the alternate attribute for assessing aquatic integrity at the DAU scale. A summary of primary and secondary target ecological processes by mitigation area is presented in Table 2.

Table 2: Primary and Secondary Ecological Processes Targeted by Mitigation Area.

Mitigation Area	Ecological Process		
	Water	Sediment	Aquatic Integrity
Coal Creek	Primary	Secondary	
Lakehurst	Primary		
May Creek	Primary	West ½ - Secondary	East ½ - Secondary
Kennydale	Primary		
North Renton/John's Cr.	Primary		
Cedar River	Primary		Secondary

We reviewed existing literature for each mitigation area and found no available landscape assessments for the condition of primary or secondary ecological processes. Therefore, we characterized the targeted ecological processes using: a) the most current available data sets (see metadata listed in Appendix K), b) methods described in Gersib et al. (2004), and c) landscape indicators identified in Table 3.

Table 3: Landscape Attributes Used to Characterize Target Ecological Processes.

Targeted Ecological Processes	Landscape Attributes Used in Assessment
Delivery of Water	• Total Impervious Area • Percent Forest Area • Condition and Extent of Wetlands
Delivery of Sediment	• Bare Soils • Road Density • Unstable Slopes
Aquatic Integrity	• Primary - Benthic Index of Biological Integrity • Secondary – Delivery of Large Woody Debris
Delivery of Large Woody Debris	• Number or stream crossings • Condition of 67 Meter Riparian Stream Buffer

Characterizing the condition of an ecological process, like the delivery and routing of water, is the result of understanding the effect of human land use on two distinct components, the delivery of water (for example, the speed and method by which water is delivered to a stream system) and the routing of water (for example, the speed and means by which water moves, once it reaches a stream system). Land use patterns alter the delivery and routing of water, sediment, pollutants, large wood, and heat through a stream system. When this occurs, we make a fundamental assumption that the first and foremost priority, when seeking measurable environmental improvement, is to target the delivery component of the ecological process. Keeping excess water, sediment, etc. out of the stream system focuses on the source or core problem. Recovery efforts that seek to remove or manage the problem once it is in the stream are very different.

When land use patterns alter the delivery and routing of water, sediment, pollutants, large wood, and heat through a stream system, we make a fundamental assumption that the first and foremost priority, when seeking measurable environmental improvement, is to target the delivery component of the ecological process.

The study area has experienced alterations to both the natural delivery and routing of water and sediment. We chose, based on the rationale above, to target mitigation efforts that restore the delivery component of key ecological resources, rather than the routing component. For this reason, we focus watershed characterization efforts and resulting mitigation site selection to DAUs and sites capable of improving the delivery of water, the delivery of sediment, and aquatic integrity.

We assign a condition rank to each DAU for each landscape attribute used in the characterization of an ecological process. This ranking is based on the results of our watershed characterization. These ranks are “Properly Functioning,” “At Risk,” and “Not Properly Functioning.” Methods follow Gersib et al. (2004). We used the data sets described in Appendix K to characterize the condition of target ecological processes. When multiple landscape attributes were used to determine the condition of an ecological process, we established and followed a set of rules to assign an overall condition rank for each target ecological process by DAU. Rules used to establish the overall condition rank follow Gersib et al. (2004).

Our primary targets for restoration actions are DAUs having a condition rank of "At Risk" for the primary or secondary ecological process. We consider DAUs having a target ecological process rank of "Properly Functioning" to be a high priority for preservation activities and are not targeted for recovery. On the flip side of the coin, "Not Properly Functioning" DAUs are considered more appropriate for educational activities and were also not targeted for recovery.

Delivery of Water

Figure 11 shows an overall condition rank of DAUs for the delivery of water, under current land cover conditions, based on watershed characterization results. Appendix C presents each landscape attribute's condition rank, as used in determining the overall condition rank of each DAU.

Following methods used to characterize ecological processes under current land cover conditions, a future build-out scenario was developed and used to characterize the delivery of water under future land cover conditions.

Growth Management Act Comprehensive Plans developed by local jurisdictions were used to develop the future land cover coverage. The purpose of this step is ensure that targeted "at risk" DAUs under current land cover conditions for the delivery of water won't change dramatically in the future, reducing the potential that some functions can be maintained.

> ***Our primary targets for restoration actions are DAUs having a condition rank of "At Risk" for the primary or secondary ecological process.***

Results indicate that human land use has substantially altered the amount and timing of water being delivered to streams within the western one third of the study area. These alterations will remain the same or increase in the future based on the future buildout land cover condition. All DAUs that intersect or abut the project area are rated "Not Properly Functioning" for both current and future build-out conditions. DAUs considered to be "At Risk" for the delivery of water do exist in the study area but occur only in the upper half of the May Creek watershed and upper two thirds of the Cedar River portion of the study area.

Project DAUs and surrounding DAUs exhibit substantial alteration to the natural delivery of water. This indicates that stream systems crossing under I-405 have increased peak flows and reduced low flows. Increased peak flows result in destabilized stream banks, as the channel widens to accommodate the additional flows. Increased peak flows and associated increases in sediment loads in "Not Properly Functioning" DAUs result in cumulative effects that compound the level of degradation as water and sediment moves downstream. Other signs of stream degradation include changes to riparian vegetation, reduction in channel complexity due to the mobilization of LWD, reduced summer low flows (even complete channel dewatering), and loss of flood storage to wetland and riparian areas associated with the stream system. In turn, this effects the quantity and quality of habitat that the stream system provides to both fish and wildlife.

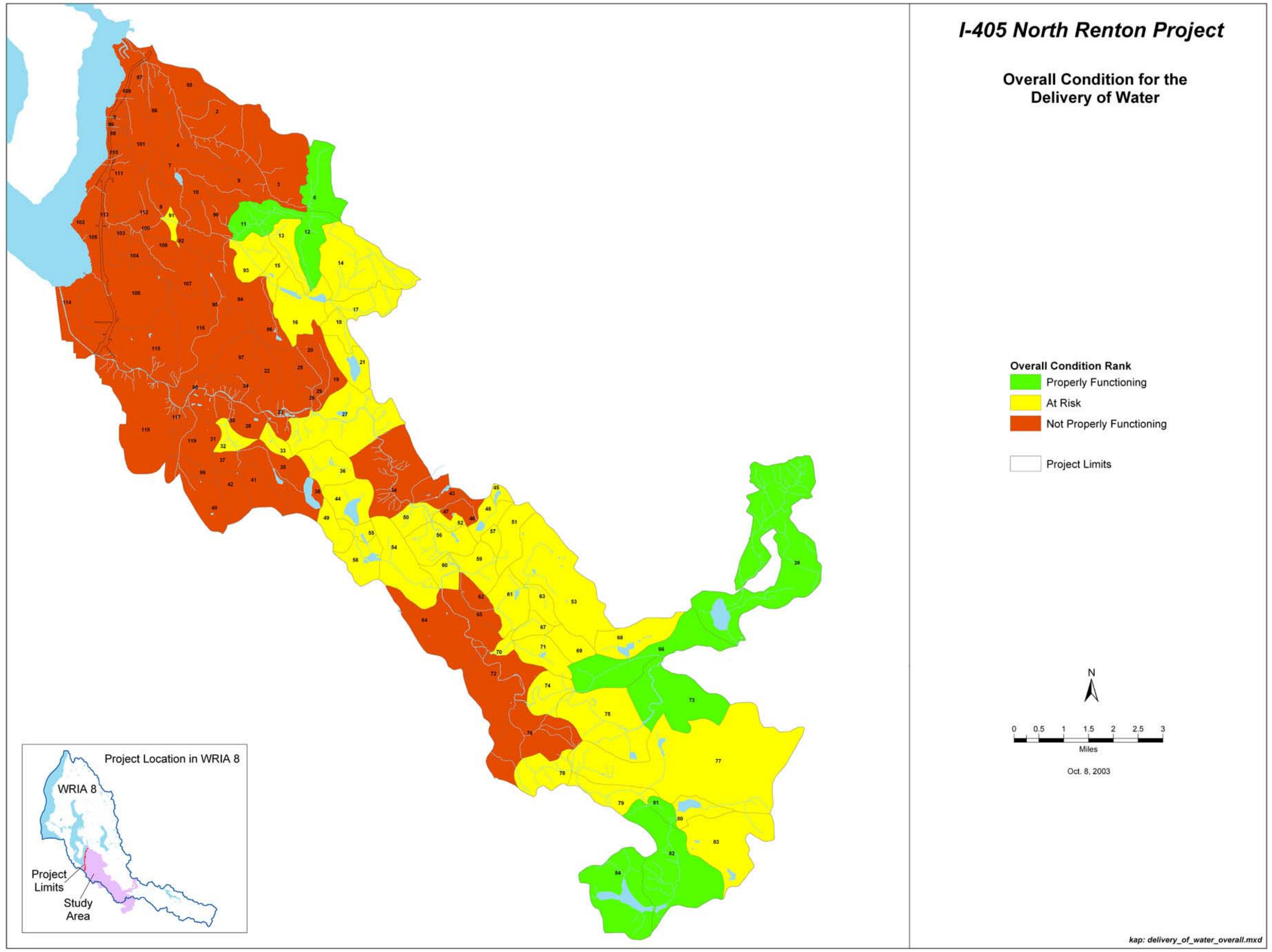


Figure 11: Delivery of Water Under Current Land Cover Conditions

We seek to target mitigation efforts that restore the delivery of water in DAUs ranked as "At Risk." This gives our mitigation efforts the greatest potential to result in measurable environmental benefit at the DAU scale. We ranked most of the DAUs in the western third of our study area as "Not Properly Functioning" for the delivery of water. As a result, the opportunity to see measurable improvement to the delivery of water at a DAU scale is greatly reduced. The only way we could see measurable improvement would be if our own efforts were integrated into an extensive non-regulatory recovery effort for the DAU.

Regulations sometimes require us to restore ecological processes within DAUs listed as "Not Properly Functioning." In these cases, efforts should target:

- Stream headwater wetlands;
- Intact or degraded wetlands; and/or
- Riparian areas having an upslope forested catchment where the delivery of water is considered to be "Properly Functioning" or "At Risk" for that portion of the DAU.

Wetlands or riparian areas under these scenarios are candidates for restoration actions because of their landscape position and potential value and importance to the overall DAU.

Delivery of Sediment

Figure 12 shows an overall condition rank of DAUs for the delivery of sediment, under current land cover conditions, based on watershed characterization results. Appendix C presents each landscape attribute's condition rank, as used in determining the overall condition rank of each DAU.

Results indicate a mixture of "At Risk" and "Not Properly Functioning" DAUs for the delivery of sediment upslope and downslope of I-405. Based on these results, we assume that within DAUs ranked as "Not Properly Functioning," substantial alteration in the amount and timing of fine and course sediment being delivered to a stream has resulted from human land use. We further assume that within DAUs ranked as "At Risk," human land use causes some increase in the amount and timing of fine and course sediment being delivered to a stream. These alterations will either remain the same or increase in the future, based on the potential for additional forest clearing on unstable slopes and increase in road density.

Substantial alteration to the natural delivery of sediment within DAUs upslope of the project area results in increased sediment loading to a steam. Increased sediment loading is the result of fine sediment inputs from surface erosion of unvegetated areas as well as from bank erosion, especially in urbanized areas. It also may result from fine and coarse sediment inputs resulting from slope failure associated with development and forest clearing on unstable slopes. We assume that degradation of key landscape indicators (percent bare soils, road density, and percent forest cleared on unstable slopes) result in an average increase in the delivery of sediment to a stream. However, some sediment delivery processes, such as slope failure, are episodic in nature and are less predictable than fine sediment loading associated with surface erosion from an agricultural field. A substantial increase in the delivery of sediment to a stream can result in the degradation of wetland and riparian areas through sediment deposition, reduction in stream channel complexity due to the filling of pools, and burial of LWD.

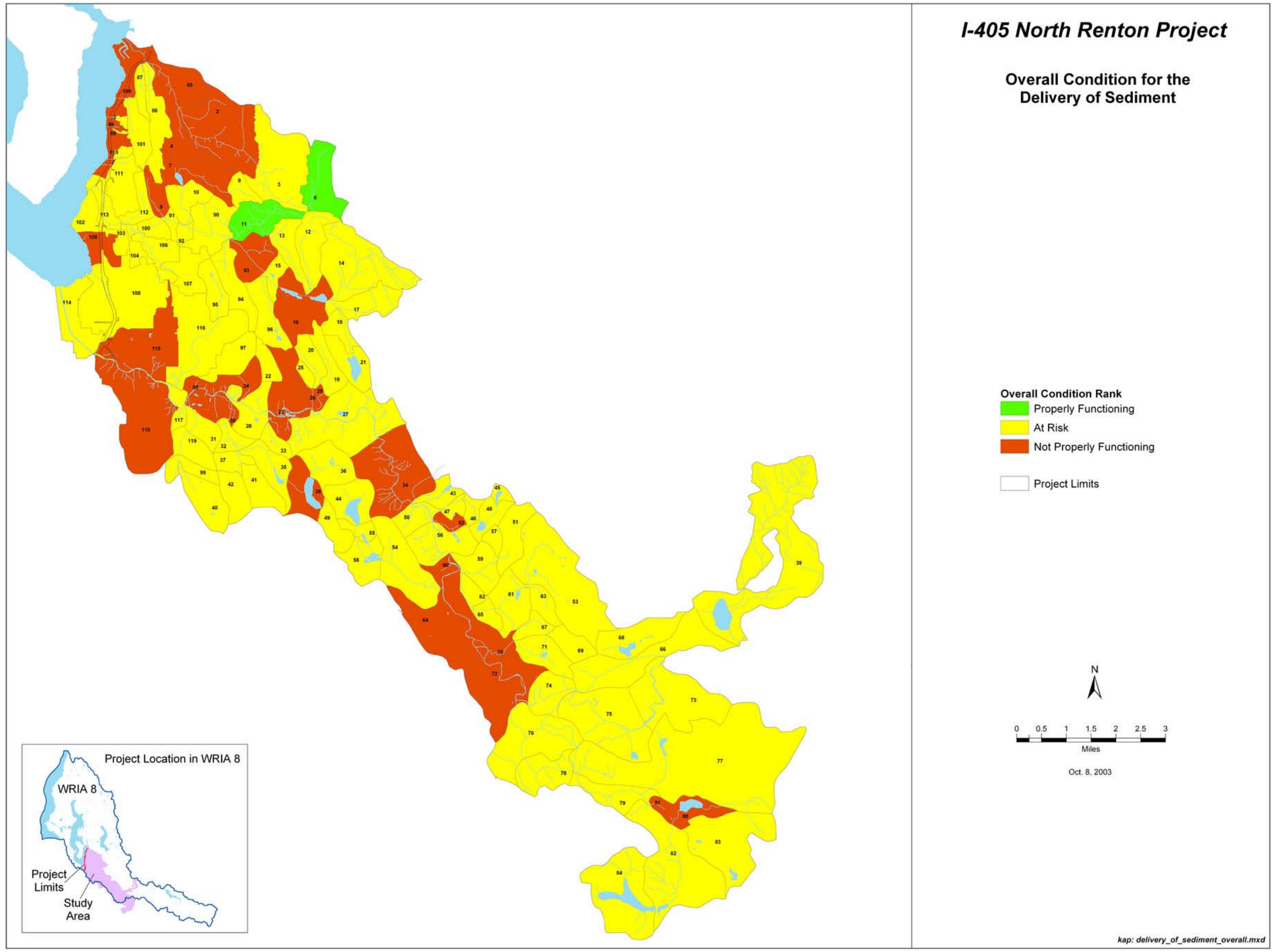


Figure 12: Delivery of Sediment Under Current Land Cover Conditions

Increased sedimentation of wetland and riparian resources results from changes in the delivery of sediment associated with “Not Properly Functioning” DAUs located upslope of the project area. In DAUs considered to be “Not Properly Functioning” for the delivery of sediment, we assume that these wetland and riparian resources remain capable of providing a sediment retention function even under a degraded baseline condition. However, the physical ability of these wetlands and riparian areas to maintain existing functions under degraded baseline conditions is reduced.

Exceptions to these assumptions must be made when permitting agencies require mitigation of sediment impacts within DAUs performing in a “Not Properly Functioning” condition. Under this scenario, restoration efforts should target:

- Stream headwater wetlands;
- Intact or degraded wetlands; and/or
- Riparian areas having an upslope forested catchment where the delivery of water is considered to be “Properly Functioning” or “At Risk” for that portion of the DAU.

Wetlands or riparian areas under these scenarios are candidates for restoration actions because of their landscape position and potential value and importance to the overall DAU.

Aquatic Integrity - Primary

When data were available, we used the Benthic Index of Biological Integrity or “B-IBI” (Karr and Dudley, 1981) as the landscape indicator for aquatic integrity. Data availability limits the applicability of this ecological process indicator to the May Creek catchment, the upper reaches of Coal Creek, and less than half of the DAUs in the Cedar River mitigation area. Existing B-IBI scores for May Creek indicate that the entire May Creek catchment is “At Risk” for aquatic integrity. This indicates that human land use has reduced aquatic integrity, but not to the extent that stream conditions limit or preclude potential for recovery. While substantial portions of the Cedar River and Coal Creek mitigation areas have no data, what B-IBI scores exist do provide some direction on where to target and where to avoid recovery efforts.

Figure 13 shows an overall condition rank of DAUs for aquatic integrity, under current land cover conditions, based on watershed characterization results.

Aquatic Integrity - Secondary

In the absence of B-IBI data, we use the delivery of LWD to characterize the condition of aquatic integrity. Figure 14 presents characterization results for the delivery of LWD. Appendix C presents the condition rank of each landscape attribute used in determining the overall condition rank for the delivery of LWD in each DAU.

LWD serves as an important habitat component of stream systems and is used here as a substitute when B-IBI is not available to characterize aquatic integrity. We assume that riparian deforestation is the primary factor altering the potential of a stream to recruit LWD. Results indicate a mixture of “At Risk” and “Not Properly Functioning” DAUs for the delivery of large wood both upslope and downslope of I-405. “Not Properly Functioning” DAUs usually have land use alterations that result in a substantial reduction in the amount of large wood being delivered to a stream (and a corresponding loss of aquatic integrity).

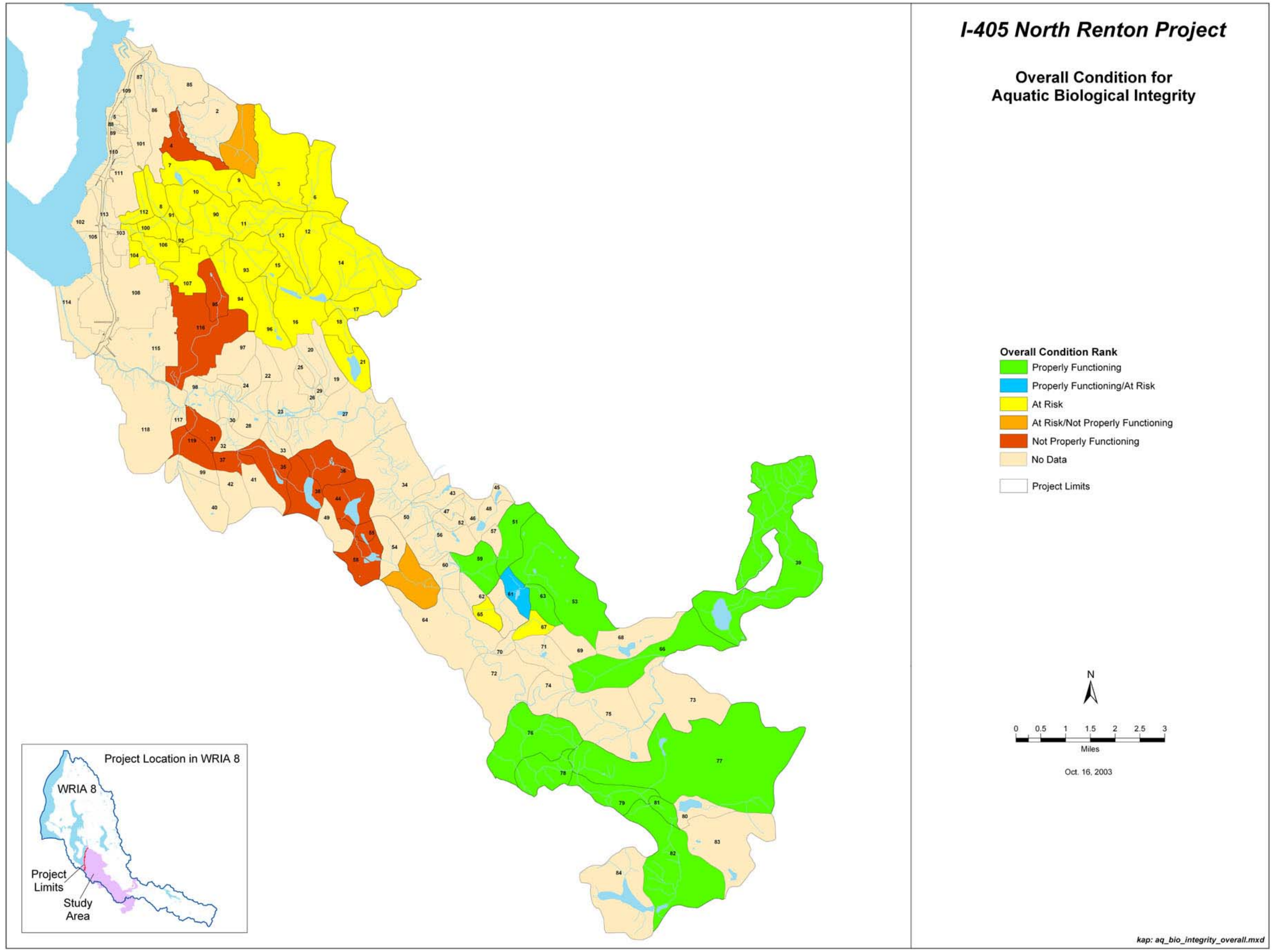


Figure 13: Aquatic Integrity Under Current Conditions

Even under "Not Properly Functioning" conditions, stream systems still provide some habitat functions that can't be ignored. However, we assume our focus must be on DAUs ranked as "At Risk" when we want to target mitigation efforts to sites that have the greatest potential to result in measurable environmental benefits. While future conditions can't be quantified, riparian areas will most likely remain in their current condition or improve due to local and state protection efforts.

Exceptions to these assumptions must be made when permitting agencies require mitigation of habitat loss within DAUs performing in a "Not Properly Functioning" condition. Under this scenario, restoration efforts should target:

- Stream headwater wetlands;
- Intact or degraded wetlands; and/or
- Riparian areas having an upslope forested catchment where the delivery of water is considered to be "Properly Functioning" or "At Risk" for that portion of the DAU

Wetlands or riparian areas under these scenarios are candidates for restoration actions because of their landscape position and potential value and importance to the overall DAU.

Other Ecological Processes

Additional impacts to the study area have occurred that are not quantifiable when characterizing ecological processes at the DAU scale. Impacts include major hydrologic alterations to the Cedar River, Lake Washington, and tributary streams.

Major Hydrologic Alterations

We are not always able to quantify certain additional impacts to the study area when characterizing ecological processes at the DAU scale. These impacts include major hydrologic alterations to the Cedar River, Lake Washington, and tributary streams.

At the turn of the century, the City of Seattle began to withdraw water from the Cedar River for its municipal supply needs and later constructed a reservoir complex that continues to help meet the municipal water needs of Seattle. In the early 1900s, two major construction projects resulted in profound hydrologic and ecologic impacts (Kerwin 2001). The first was the construction of the Lake Washington Ship Canal and its associated locks. The locks then became the outlet to the lake, which had previously drained through the Black River at the south end of the lake. This change was followed closely by the redirection of the Cedar River. Historically, the Cedar River flowed into the Black River which then flowed into the Duwamish River and Elliott Bay. The Cedar River's natural flow path was redirected into Lake Washington. These alterations resulted in the following effects:

- Lake water flow paths altered – The natural outlet of Lake Washington was changed from the Black River on the south end of the lake to the Lake Washington Ship Canal to the northwest.
- Lake levels altered – The level of Lake Washington dropped approximately nine feet.
- Lake area altered and tributary streams impacted – The shoreline changed dramatically along with the confluence of all lake tributary streams.

- Lake wetlands and their shoreline stability lost – Wetlands associated with the Lake Washington shoreline and adjacent to it were dewatered.
- Cedar River flow lost – Over the past 50 years, the City of Seattle removes on average approximately 22 percent of the Cedar River flow (Kerwin 2001).

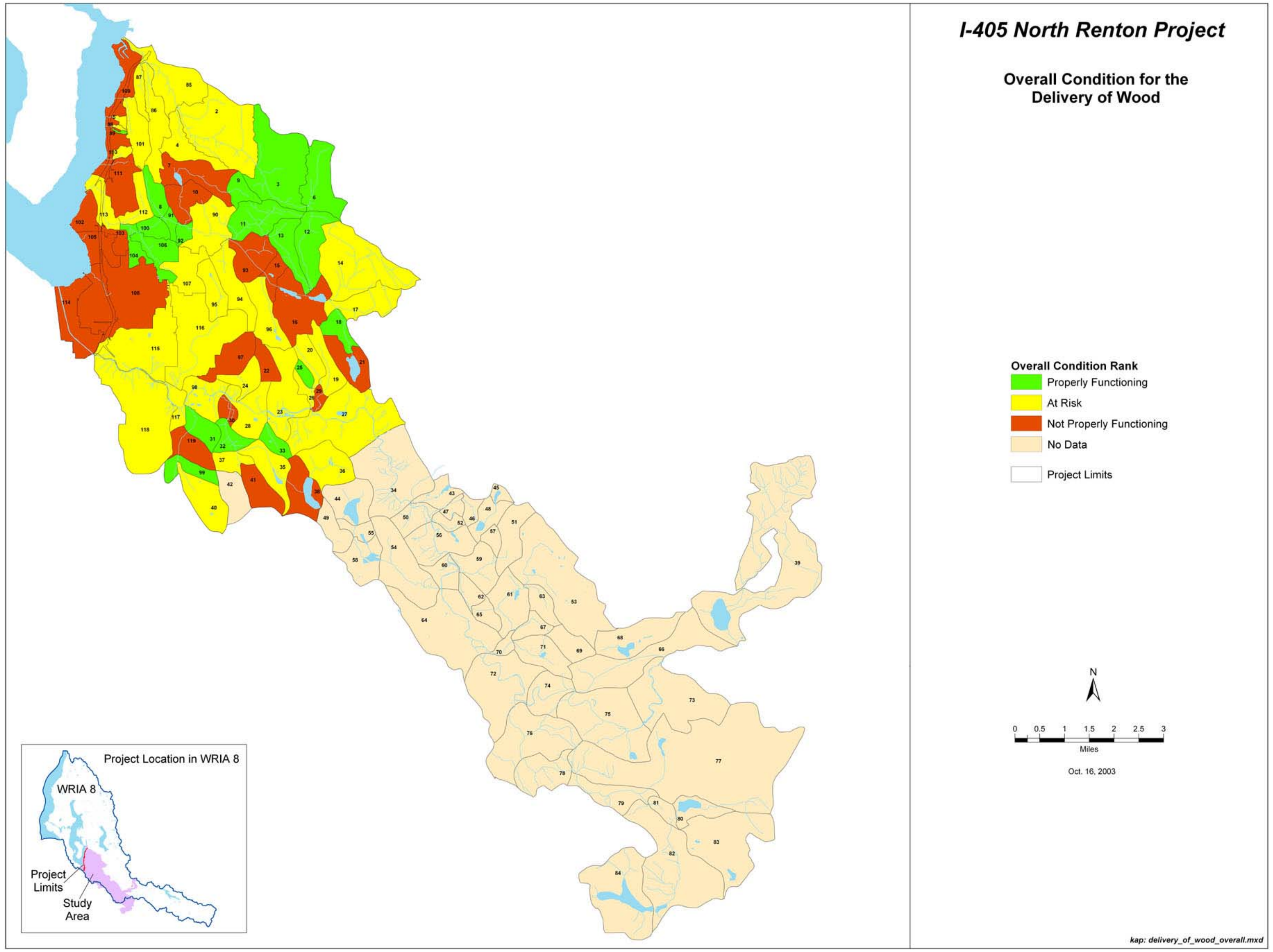


Figure 14: Delivery Of Large Woody Debris Under Current Land Cover Conditions

IV. Assessing the Project Site

1. Transportation Project and Setting

The North Renton piece of the overall project extends approximately seven miles from immediately north of the Cedar River bridge, north to Exit 10 (just north of Coal Creek). Figure 12 is a map of the project area.

The "I-405 Congestion Relief and Bus Rapid Transit Projects Corridor Final Environmental Impact Statement" (Washington State Department of Transportation, 2002) contains the overall preferred alternative for I-405. WSDOT based the preferred alternative on Alternative 3 from the draft Environmental Impact Statement, with minor changes. Proposed improvements to I-405 in the North Renton area are part of the preferred alternative. Under the preferred alternative, WSDOT proposes to substantially improve mobility for rapid transit, high occupancy vehicles, and for general purpose traffic. Improvements include arterial high occupancy vehicle priority for transit, additional park-and-ride capacity, more bus stations, transit center improvements, freeway high occupancy vehicle direct access, two new lanes in each direction on I-405, and improvements to major interchanges.

I-405 in the area of the North Renton project crosses low terraces above Lake Washington. It also crosses three fish bearing streams (Coal Creek, May Creek, and the Cedar River) and intersects several areas (the Lakehurst, Kennydale, and North Renton/Johns Creek areas) that drain to Lake Washington through urban storm drains and remnant creeks.

The project passes through parts of four jurisdictions. Approximately the southern half of the project lies entirely within the City of Renton. A short stretch (about one-half mile) north of that lies on the boundary between the City of Newcastle (to the east) and a tiny piece of unincorporated King County to the west, on the shore of Lake Washington. North of this area, the rest of the project lies within the boundaries of the City of Bellevue.

Urban land uses dominate areas near the highway. Most areas near the project are medium to high density residential areas, with substantial industrial and commercial in the southern parts.

Land uses west of the highway from Cedar River north to the Park Avenue Interchange are mostly commercial and industrial. East of the same stretch of highway, and north of Park Avenue on both sides of the freeway in Renton, multi-family and high-density single family residential areas dominate. Most of these areas began to develop as early as the 1920s, with dense suburban development beginning in the 1950s. Suburban neighborhoods covered most remaining areas of available residentially-zones land in the 1970s and 1980s.

The small piece of Lake Washington lakefront west of the highway that is in unincorporated King County is covered with high density, high value waterfront homes, mostly built between the 1950s and the 1980s. East of this part of the project, most of Newcastle near I-405 is in single family housing. Like northern Renton, much of this area was converted from farms, forests and fields in the 1970s and 1980s.

This pattern continues in Bellevue south of the Coal Creek Parkway Interchange. High density, high value waterfront homes of varying ages (back to the 1940s) line the shores of Lake Washington west of the highway, and medium to high density single family residential areas cover the slopes to the east of the highway. The northernmost piece of the project, from Coal Creek Parkway to I-90, lies between commercial areas to the east and high density single family homes, most dating fro the 1960s, to the west.

Within these more generalized land uses, there are small areas that remain in a more undeveloped state. Immediately north of the Cedar River in Renton, both sides of I-405 are lined with developed city park. Along the highway further north in Renton, remnant stands of second-growth forest (maple, alder, madroña, Douglas-fir) grow on steep slopes. May Creek parallels I-405 to the east for about three-quarters of a mile in north Renton; here a similar mixed second-growth forest remains, partly on private land and partly on portions of May Creek Park. Continuing to the north, more stands of mixed forest may be found on steep slopes and in the freeway right-of-way, and several small areas of riparian forest line small streams crossing the highway. A more extensive area of riparian forest lies to the east of the highway where Coal Creek goes underneath.

Near the major streams and some tributaries, there are riparian zones and small wetlands, some of them fish habitat. The next part of this chapter discusses the aquatic and terrestrial resources in the project area and estimated project impacts to these resources.

2. Potential Project Impacts to Aquatic and Terrestrial Resources

Natural resource inventory and assessment are essential to quantifying the magnitude of potential project impacts to aquatic and terrestrial resources. We use this information to identify key natural resources within the project limits of construction that warrant priority consideration for avoidance and minimization, while gaining understanding of the type, magnitude, and functions of natural resource impacts that may require mitigation.

Project limits of construction are confined to narrow strips on each side of I-405 extending approximately seven miles from the Cedar River north to Exit 10, just north of Coal Creek. An accurate estimate of direct impacts to regulated resources is not possible because project alignment has not been finalized. For planning purposes, we assume that all natural resources within the project limits of construction will be directly impacted by the project. While we know that this will not be the case, we use the worst-case scenario to ensure that all potential types of natural resources at risk are identified, the extent of potential impacts quantified, and functions assessed that may require mitigation.

Fish Distribution and Fish Use

Three ESA-listed fish species are known to occur in streams that cross the North Renton section of the I-405 corridor (Table 4). Distribution of anadromous fish within the study area is summarized in Figure 16.

Table 4: Occurrence of ESA Listed Species Within Project Limits of Construction.

Common Name	Scientific Name	Status
Puget Sound chinook salmon	*Oncorhynchus tshawytscha*	Threatened
Puget Sound bull trout	*Salvelinus confluentus*	Threatened
Puget Sound coho salmon	*Oncorhynchus kisutch*	Candidate

Figure 14 represents the know and presumed distribution to Puget Sound chinook salmon, Puget Sound bull trout/dolly varden, and Puget Sound coho salmon. Based on this information, we assume that these three ESA-listed species are restricted to the three major stream systems (Coal Creek, May Creek, and the Cedar River) and their tributaries within the study area. We have found no evidence of ESA listed fish occurrence in the small tributary streams that drain to Lake Washington and are crossed by I-405. Distribution maps indicate that Puget Sound bull trout/dolly varden are restricted to the Cedar River, while Puget Sound chinook and coho salmon occur in all three major stream systems.

Natural Resources Assessment

WSDOT wetland biologist William Null walked the project area and conducted a wetland inventory in August, 2003. He prepared a detailed wetland report and results, which is presented in Appendix H. Wetland determinations are based on methods set forth in the Washington State Wetlands Identification and Delineation Manual (Ecology, 1997). All wetland area calculations are estimates based on a visual assessment and are not intended to be technically rigorous wetland delineations. We then transferred all wetland data to a GIS data file for further analysis. We derived forested riparian area coverage from the riparian restoration database, as described elsewhere in this report.

Fisheries habitat biologist Kurt Buchanan, with the DFW, evaluated stream resources within the project area. His detailed report summarizing findings of stream resource assessment is presented in Appendix G.

We used existing Federal Emergency Management Agency (FEMA) maps and based topographic data from LIDAR to identify floodplains. LIDAR is an acronym for “Light Detection And Ranging,” which is a system for gathering high accuracy topographic data utilizing airborne lasers. FEMA maps identify 100-year floodplains for the Cedar River, May Creek, and Coal Creek. May and Coal creeks are confined within their channels at I-405, and we assume that the project will cause minimal loss of floodplain at these locations. The Cedar River bridge will span the majority of its floodplain, and, again, we assume that the project will have minimal floodplain impacts.

Wetlands

We identified a total of 21 wetlands within the project limits of construction. Seventeen of these are primarily of natural origin, while four have been significantly altered to function as stormwater detention ponds. All are considered jurisdictional wetlands, including the detention ponds (because they are constructed in hydric soils). Table 5 summaries findings.

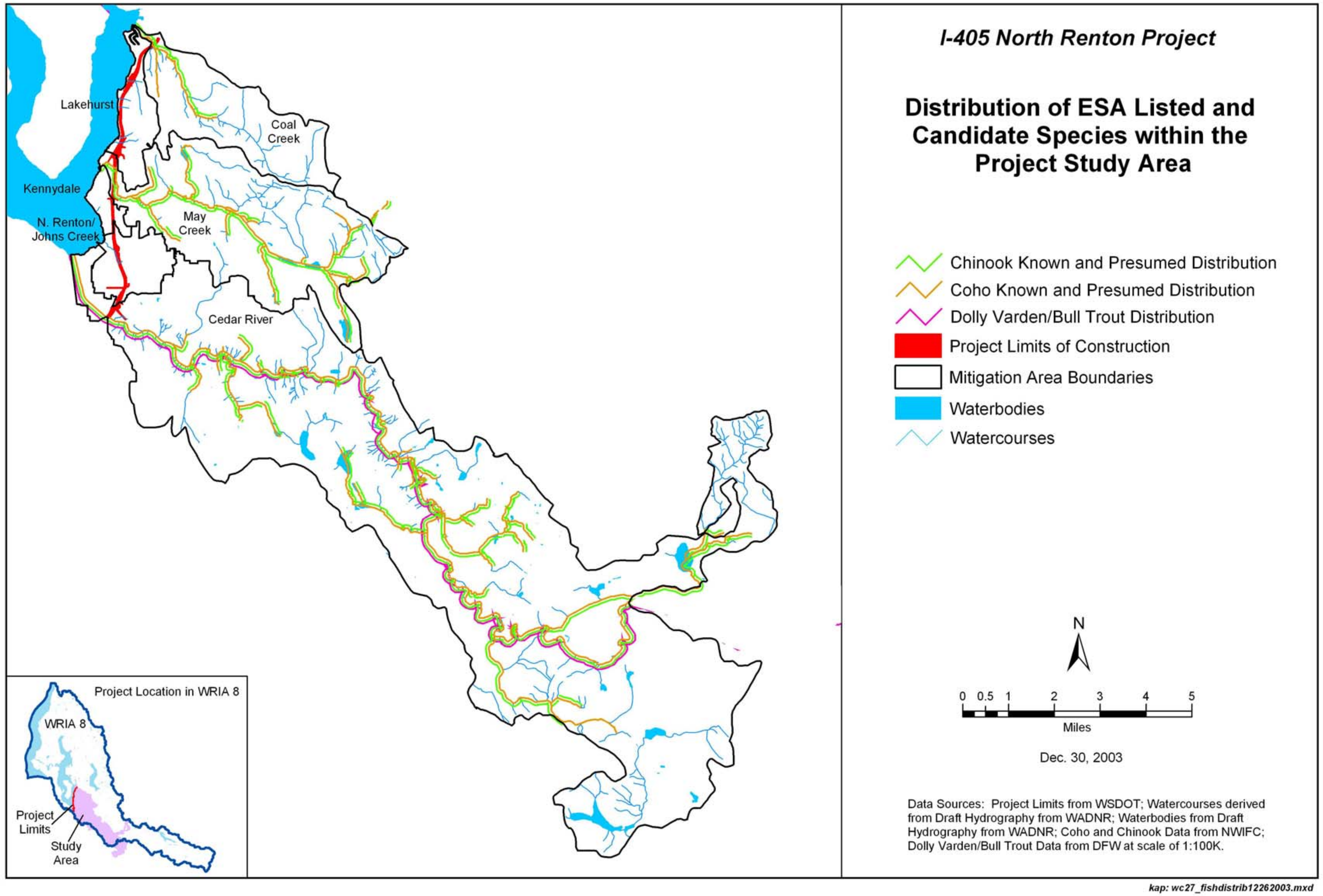


Figure 15: Distribution of Anadromous Fish Within The Study Area

Table 5: Summary of Wetland Resources Within Project Limits of Construction.

Field ID	Wetland ID	Classification [1]	Ecology Rating [2]	Approximate Size (in acres)
A	W9	PEM	III	0.02
B	W10	PFO	III	0.03
Ca	W27	PFO	III	0.01
Cb	W28	PFO	III	0.01
D	W500	PEM	III	0.004
E	W31	PFO	II	1.5
F	W45	PFO	II	3.5
G	W85	PFO	III	0.5
H	W98	PSS	III	1.0
I	W72	PFO/EM	III	0.5
J	W41	PFO	II	5.5
K	W37	PFO	III	0.25
L	W30	PEM	III	0.007
M	W26	PFO/SS/EM	II	2.0
N	W14	PEM	III	0.005
O	W12	PEM	III	0.05
P	W11	PFO/EM	III	0.5
Stormwater detention ponds that are jurisdictional wetlands				
South 1	W39	Did not class	Did not rate	0.5
South 2	W501	Did not class	Did not rate	0.5
North 1	W38	Did not class	Did not rate	1.0
North 2	W502	Did not class	Did not rate	0.5

Field ID	Wetland ID	Classification [1]	Ecology Rating [2]	Approximate Size (in acres)
Total				≈18.00

[1] Classification of wetlands (Cowardin, et. al., 1979).

[2] Washington State Wetlands Rating System (Ecology, 1993).

PFO = Palustrine Forested wetland

PSS = Palustrine Scrub-Shrub wetland

PEM = Palustrine Emergent wetland

Ecology Rating = Categories I through IV, where I is of the highest quality rank and IV is of the least quality rank

We used a characterization tool specifically developed for evaluating wetland functions (WSDOT, 2000) to assess wetland functions. This assessment identified both principal and secondary functions of each wetland. Functions assessed include:

- Flood flow alteration
- Sediment retention
- Nutrient and toxic removal
- Erosion control and shoreline stabilization
- Production of organic matter and its export
- General habitat suitability
- Habitat for aquatic invertebrates
- Habitat for amphibians
- Habitat for wetland-associated mammals
- Habitat for wetland-associated birds
- General fish habitat
- Native plant richness

Appendix H presents the results of this site-specific function assessment work. Assessment findings indicate that 13 of 17 wetland sites provide “Production of Organic Matter and Its Export” as a principle function, while four of 17 wetlands provide “Habitat for Aquatic Invertebrates” as a principal function. No other specific wetland function is identified as a principal function for more than three wetlands.

Riparian Areas

We developed a GIS data layer (which is described later) that identifies forested and non-forested areas in the 67 meter riparian buffer of streams within the study area. The maximum forested riparian area potentially effected by the project was calculated by overlaying this dataset onto the project limits of construction. Forested riparian resources occur within the project limits of construction in the Lakehurst, May Creek, North Renton/ Johns Creek, and Cedar River basins. We assume that these areas provide the following functions:

- Stream channel complexity and fish habitat associated with the recruitment of large wood
- Flood flow alteration
- Sediment, nutrient, and toxicant retention
- Erosion control and bank stabilization
- Stream temperature attenuation
- Organic export
- General habitat

A worst-case scenario for direct project impacts to riparian areas within the project area was calculated and summarized in Table 6.

Table 6: Summary of Potential Project Impacts to Riparian Systems.

Mitigation Area	Direct Project Impacts - Worst Case Scenario
	Riparian
Coal Creek	None
Lakehurst	2.1 acres
May Creek	0.7 acres
Kennydale	None
N. Renton/John's Cr.	2.6 acres
Cedar River	0.4 acres

Floodplains

Based on Federal Emergency Management Agency 100-year floodplain data, potential floodplain impacts of the project are restricted to the Cedar River floodplain. Based on the potential impacts to ESA listed fish species and the assumption that the floodplain will be bridged in a similar manner as the existing bridge structure, minimal floodplain impacts are expected, even in a worst-case scenario.

Habitat Assessment

Table 7 summarizes observations and general conclusions of fisheries biologist Kurt Buchanan regarding habitat conditions by stream system. Appendix G contains the complete Kurt Buchanan report on stream habitat conditions.

Table 7: Summary of Stream Habitat Condition

Basin	Project Area Summary of Habitat Condition
Coal Creek	• Overall stream condition poor; habitat condition very poor • Stream culverted under I-405; fish passage as good as possible • Open channel is riprap lined with little riparian corridor • A major unresolved source of poor quality water enters up-slope of project • Little opportunity for restoration within I-405 project area
May Creek	• I-405 bridges the stream; stream conditions good for urban stream • Entire stream channel has riprap armored banks; cottonwoods colonizing • Gravel sufficient size for spawning, with some fines • Spawning and rearing of chinook, sockeye, coho salmon, and peamouth chub are expected sporadically • Recommends keeping what habitat and vegetation there is in project area
Cedar River	• Appears entire right-of-way is covered by the I-405 bridge • Channel is riprap lined with multiple stormwater outfalls • Area used for spawning by chinook and sockeye; limited rearing habitat • Little ability to improve habitat within right-of-way; channel capacity limited

Stormwater Impacts

New pavement from the North Renton project will increase stormwater runoff rates and pollutant loadings. Federal and State regulations require WSDOT to mitigate stormwater impacts to flooding, stream erosion, and water quality.

The I-405 Environmental Impact Statement identified a range of project alternatives. To provide a conservative assessment of potential stormwater mitigation needs, WSDOT's Urban Corridors Office assumes the project will add three new lanes in each direction. Based on this scenario, we estimate that the North Renton project will add 82 acres of new impervious area. This combines with the existing paved area to bring the total project impervious area to 174 acres.

The North Renton project crosses three fish bearing streams (Coal Creek, May Creek, and the Cedar River). It also intersects several areas (the Lakehurst, Kennydale, and North Renton/Johns Creek areas) that drain to Lake Washington through urban storm drains and remnant creeks (see Figure 10, Drainage Basins and Soils). Project stormwater impacts are quantified for each of these drainage basins. Table 8 lists the project impervious area within each drainage basin, and identifies the change in TIA (percent) for each basin before and after project construction.

WSDOT's Highway Runoff Manual requires projects to provide retrofitted stormwater mitigation for existing pavement when new surfaces increase the total impervious area by 50 percent or more within the project area. We are assuming that full retrofit will be required for the North

Renton project, meaning that stormwater mitigation will be required for the entire 174 acres of new and existing impervious area. Flow impacts, storage requirements, and water quality impacts are quantified below based on this assumption.

Table 8: Project Impervious Areas and Drainage Basin Total Impervious Area

Drainage Basin	**Total Project Impervious Area (acres)**	**New Impervious Area (acres)**	**Basin TIA (percent)**	
			Pre-project	**Post-project**
Coal Creek	10	4	21.3	21.4
Lakehurst	45	22	30.7	32.4
May Creek	50	24	17.6	17.8
Kennydale	9	4	49.5	50.4
North Renton	45	21	60.3	61.8
Lower Cedar R.	14	7	15.1	15.1
TOTAL	**174**	**82**		

Potential Water Quantity Impacts and Mitigation Needs

We quantified project flow impacts by simulating runoff from the project impervious areas with WSDOT's MGS-FLOOD model. MGS-FLOOD is a continuous rainfall-runoff model that simulates hourly runoff from paved, landscaped, pastured, and forested land covers. The model sizes storage facilities to mitigate stormwater flow impacts.

Ecology's regulations require impacts to be defined relative to a pre-developed land cover. Unless site-specific historical data are provided, the default assumption is the forested land cover common in Western Washington before European settlement. WSDOT is currently in the process of identifying alternative pre-developed scenarios for highway corridors. Until this issue is resolved, we estimate the North Renton stormwater impacts relative to forested land cover.

Table 9 summarizes impacts to two-year and 100-year peak runoff rates from the project area within each drainage basin. Paved areas generate an average of 33 inches of annual runoff, compared to only seven inches from forested till soils. Paving forested land on till soils increases the 100-year peak flow rate from 50 cfs per square mile to 390 cfs per square mile. Impacts are much greater where the highway covers outwash soils (May Creek, Kennydale), since these soils produce almost no runoff under forested conditions.

Table 9: Project Impacts to Flow and Storage

Drainage Basin	Peak Flow (cfs)				Storage Required (acre-feet)[1]
	2-year		100-year		
	Forest	Impervious	Forest	Impervious	
Coal Creek	0.2	2.5	0.8	6.0	5.0
Lakehurst	0.9	12	3.6	27	23
May Creek	0.6	13	2.3	30	86
Kennydale	0.01	2.3	0.04	5.6	Not feasible[2]
North Renton	0.8	12	3.0	27	36
Lower Cedar R.	0.3	3.7	1.1	8.7	7.4
TOTAL					**157**

[1] Storage at top of outlet structure for detention ponds designed to maintain pre-developed flow durations, assuming no infiltration.

[2] MGS-FLOOD could not find a feasible storage design on basins underlain entirely by outwash soils. Infiltration is needed in these areas to provide effective flow control.

Stream erosion impacts are usually mitigated using storage and infiltration to control the duration of peak flows from the project area. Table 9 lists the storage volumes that would be required in each drainage basin to maintain pre-developed peak flow rates and durations. These volumes represent the capacity of a hypothetical detention pond at the top of the outlet structure, and assume no infiltration within the pond.

Mitigation on till soils requires about 0.5 acre-feet of storage per acre of impervious area. The required storage volumes are much greater in areas where the highway covers outwash soils. In areas where the highway is entirely underlain by outwash soils (such as Kennydale), the model could not find a feasible storage design. Because outwash soils generate little runoff under pre-developed conditions, infiltration is generally needed for effective stormwater mitigation. Infiltration is a desirable option for treating stormwater flow control, (as long as groundwater protection standards are met).

Although we identify flow control storage volumes and mitigation for all of the project drainages, several of these areas may not need stormwater mitigation for flow control. The Lakehurst, Kennydale, and North Renton/Johns Creek areas drain primarily through urban storm drain systems to Lake Washington, and will probably be exempt from flow control standards. The Cedar River is not currently on the list of exempt waterbodies, but our watershed analysis shows that detention of runoff in the lower reaches of the river is unlikely to have significant impact on flooding or river erosion. The Lower Cedar River Basin and Nonpoint Pollution Action Plan

(Metropolitan King County Council, 1997) recommends a zero detention standard for areas that drain directly to the lower 17 miles of the river.

Potential Water Quality Impacts and Mitigation Needed

We used the "Simple Method," a simplified method for estimating pollutant loads, for the I-405 North Renton project (Young, 1996). For post construction estimates, we based average daily traffic (ADT) and TIA based on a modification of the preferred alternative identified in the Final Environmental Impact Statement for I-405 (WSDOT, 2002). This modification assumes that WSDOT will add three lanes in each direction of I-405. The assumption of three new lanes in each direction is a "worst case scenario" for stormwater management in the corridor.

Methods:

1. Determine ADT distributions throughout the project.
2. Calculate mean ADT throughout the designated drainage analysis units (DAUs) – see Table 10, Average Daily Traffic Estimates, below.
3. Develop ADT vs. Event Mean Concentrations (EMC) equations for key stormwater constituents – see Table 11, Event Mean Concentrations, for pre and post-project highway stormwater runoff, below.
4. Calculate pre and post project impervious areas in each DAU through the corridor.
5. Calculate pre and post project stormwater constituent annual loads in each DAU – see Table 12, Pre and post-project annual pollutant loadings in the project area.

Table 10: Automotive Daily Traffic Estimates

DAU	Starting Milepost	Ending Milepost	Mean 2003 ADT	Est. 2020 ADT$_1$
Cedar River/114-118	3.67	4.45	120,000	231,000
N. Renton-Johns Cr./108	4.45	6.17	136,000	262,000
Kennydale/102, 105	6.17	6.72	138,000	267,000
May Creek/103, 113	6.72	7.40	139,000	268,000
Lakehurst/109	7.40	10.10	141,000	271,000
Coal Creek/85	10.10	10.57	154,000	298,000

$_1$ – using the traffic estimates provided for Alternative 3 in the project EIS

Table 11: Event Mean Concentrations, Highway Stormwater Runoff

DAU	TSS_1, mg/l		P_2, mg/l		Zinc, µg/l		Dissolved Zinc, µg/l	
	2003	2020	2003	2020	2003	2020	2003	2020
Cedar River/114-118	109	154	0.36	0.29	234	384	105	185
N. Renton-Johns Cr./108	117	165	0.34	0.28	258	421	117	206
Kennydale/102, 105	117	167	0.34	0.28	260	428	119	209
May Creek/103, 113	118	167	0.34	0.28	261	429	119	210
Lakehurst/109	119	168	0.34	0.28	264	433	120	213
Coal Creek/85	125	177	.0.33	0.27	283	465	130	231

$_1$ – total suspended solids

$_2$ – total phosphorous

Table 12: Annual Pollutant Loadings in the Project Area (lbs./year)

DAU	2003				2020			
	TSS_1	P_2	Zinc	Diss-olved Zinc	TSS_1	P_2	Zinc	Diss-olved Zinc
Cedar River/114-118	6,300	21.7	13.6	6.1	16,600	31.4	41.3	11.3
N. Renton-Johns Cr./108	20,600	60.7	45.5	20.7	55,400	93.9	141.5	39.4
Kennydale/102, 105	4,200	12.3	9.3	4.2	11,400	19.1	29.3	8.1
May Creek/103, 113	23,000	66.9	51.1	23.3	62,500	103.7	160.4	44.5
Lakehurst/109	20,900	59.9	46.3	21.1	56,700	93.0	145.9	40.5
Coal Creek/85	5,200	13.9	11.8	5.5	13,000	19.6	34.2	9.6
Totals	80,200	235.4	177.6	80.9	215,600	360.7	552.6	153.4

$_1$ – total suspended solids

$_2$ – total phosphorous

3. Summary of Potential Project Effects

At an early stage of project planning and design, it is not possible to quantify the direct impacts of a project on regulated resources with any degree of accuracy. Understanding this limitation, we seek to:

a) gain understanding of potential project impacts

b) establish a priority rank for natural resources in the project area that helps optimize avoidance and minimization efforts of the project management team

c) support the early identification of sites that have potential to mitigate project impacts to regulated resources

Due to the uncertainty associated with predicting impacts to regulated resources, we chose a conservative approach based on a worst-case scenario. This decision ensures that the project management team has information available on size and function of all natural resources within the project area. Efforts by the project management team to avoid and minimize impacts to wetlands, riparian areas, streams, and floodplains will reduce the actual number and extent of natural resources lost.

We also use this worst-case scenario when estimating stormwater impacts for water quantity and quality loads for each drainage. We do, however, anticipate that the project management team will have opportunities to reduce these loading rates through planning and design. Based on a decision made jointly by the Washington State Departments of Ecology and Transportation, we focus our watershed characterization efforts on mitigating stormwater flow control. We will not identify any out of right-of-way mitigation options for the water quality impacts of stormwater. We assume that water quality treatment will occur within the project area.

Habitat impacts to ESA listed salmonids are the final regulated resource to be considered. Based on a qualitative assessment of stream habitat within the project area and the need to avoid and minimize impacts to listed species habitats, it appears possible to incur no direct adverse impacts. If direct impacts do occur to the project design, specific impacts will need to be quantified and resolved through the consultation process.

A summary of the worst-case scenario for direct project impacts to regulated resources is summarized in Table 13.

Table 13: Summary of Worst Case Scenario - Direct Project Impacts.

Mitigation Area	Wetlands	Riparian	Stormwater Storage Needed
Coal Creek	0.2 acres	None	5.0 acre-feet
Lakehurst	5.8 acres	2.1 acres	23 acre-feet
May Creek	1.3 acres	0.7 acres	86 acre-feet
Kennydale	0.03 acres	None	Infiltration
N. Renton/John's Cr.	0.004 acres	2.6 acres	36 acre-feet
Cedar River	None	0.4 acres	7.4 acre-feet

4. Recommendations for Avoidance and Minimization

WSDOT has a regulatory responsibility to avoid and minimize the project's wetland impacts. Our purpose is to integrate site-specific wetland information with landscape-scale watershed characterization results to provide the project management team with a greater understanding of the overall resource value of each wetland. Figure 16 shows wetlands in the vicinity of the project.

The wetland biologist identified wetland sites having the highest priority for avoidance and minimization during wetland inventory and function assessment work. Using best professional judgment, he identified four forested wetlands (W31, W45, W41, and W26) that warrant the greatest consideration for site scale avoidance and minimization. His selection is based on best professional judgment, on the Category II wetland ranking using the Washington State Wetlands Rating System (Ecology 1993), and on our limited ability to mitigate impacts to forested wetlands in a technically sound and cost-effective manner.

Wetlands W45 and W41 are associated with May Creek. W45 is on the west side of I-405 and W41 is on the east side (Figure 18). Both are forested wetlands providing several functions. Wetland W31, also a forested wetland, is located on the west side of the highway just north of Exit 7 (Figure 18). While smaller in size than W45 and W41, it still provides several of the same functions. The remaining Category II wetland is W26, situated on the east side of the highway just south of Milepost 8. This wetland has three separate classes of vegetation: an emergent class, a scrub-shrub class, and forested class. Like the other three wetlands, W26 provides several important functions (Figure 17).

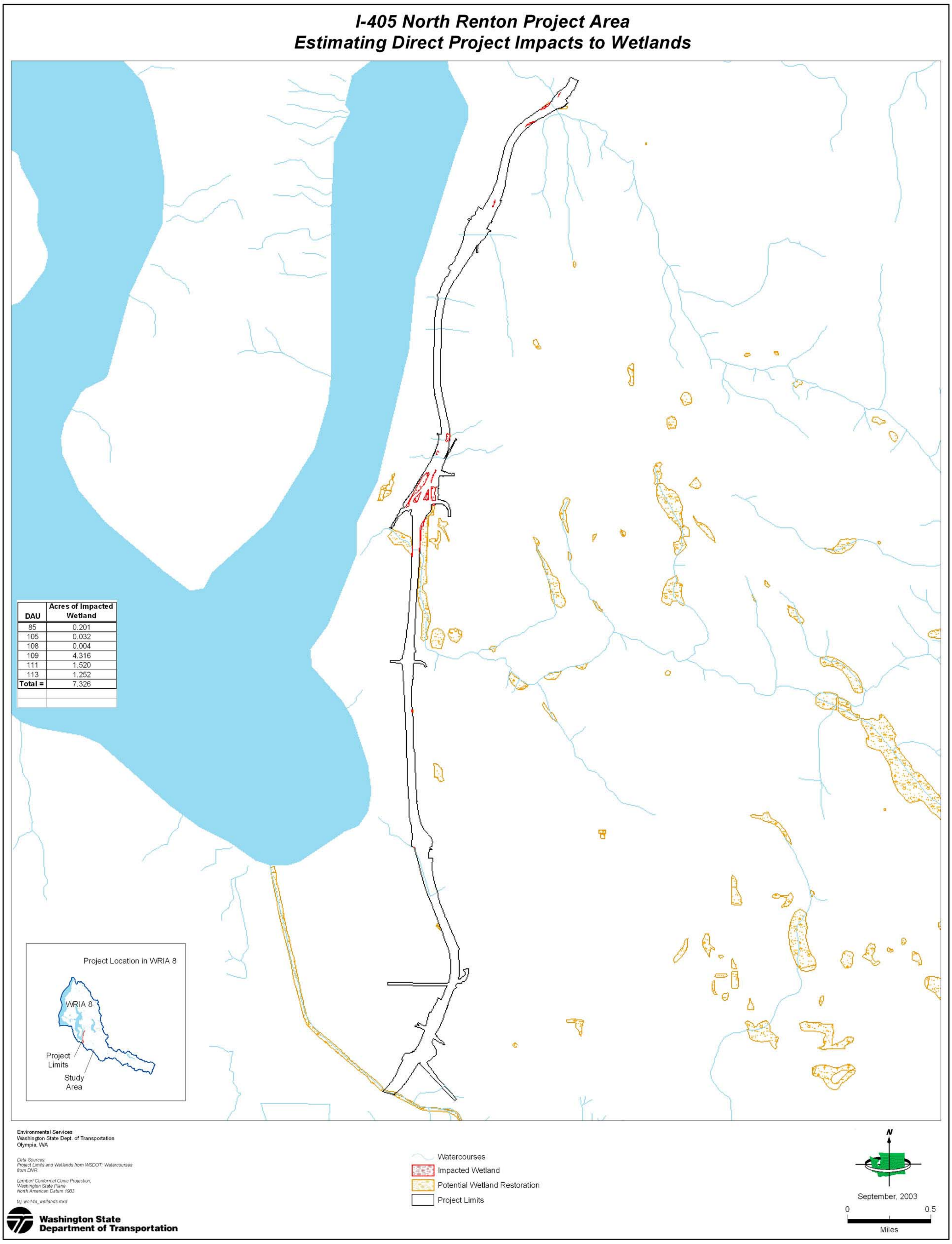


Figure 16: Wetlands in the Project Area

Watershed characterization can help us gain insight into the opportunity and effectiveness of a wetland or other resource to support key ecological processes at a landscape scale. To do this, we use products from our characterization of ecological processes, described later in this report, to help gain a better understanding of the landscape-scale human constraints placed on natural resources within the project area, and to better define the value/importance of these natural resources. Our goal is to identify natural resources having high priority for avoidance and minimization, by identifying resources that have the greatest ability to support the maintenance and recovery of landscape function.

Watershed characterization results indicate that all DAUs within and adjacent to the project area are considered "Not Properly Functioning" for the delivery of water. Human land use has substantially changed how water and other ecological processes are delivered to and routed through stream systems in the project area. When required to protect or restore ecological processes within DAUs that are listed as "Not Properly Functioning," we recommend that efforts target (a) headwater wetlands and streams, and (b) intact or degraded wetlands with upslope forested wetland and riparian areas where the delivery of water is considered to be "Properly Functioning" or "At Risk" for that portion of the DAU. Wetlands or riparian areas under these scenarios are candidates for preservation, restoration, and/or avoidance/minimization actions because of their landscape position and associated value/importance to the DAU.

Figures 17, 18, and 19 illustrate how these concepts can be used to identify priority wetland areas for avoidance and minimization of impacts.

Figure 17 shows W26, Category II forested wetland ranking high in value at the site scale. This wetland also ranks high in value at the landscape scale due to an upslope catchment that remains predominantly forested and a nearly intact upslope riparian stream buffer.

Conversely, W31, a Category II forested wetland ranking high in value at the site scale (also in Figure 17), has been isolated by roads and development and receives a moderate value ranking at the landscape scale.

Figure 18 shows two forested wetlands, W41 and W45, that have a high value at the site scale and an equally high value at the landscape scale as they support the nearly continuous forested riparian corridor of lower May Creek.

Figure 19 represents a situation where a Category III forested wetland, W10, ranking moderate in value at the site scale is ranked as high in value at the landscape scale due to its landscape position adjacent to Coal Creek and the opportunity this site has to provide both flood storage and sediment retention functions, of high importance to residents of the Coal Creek watershed.

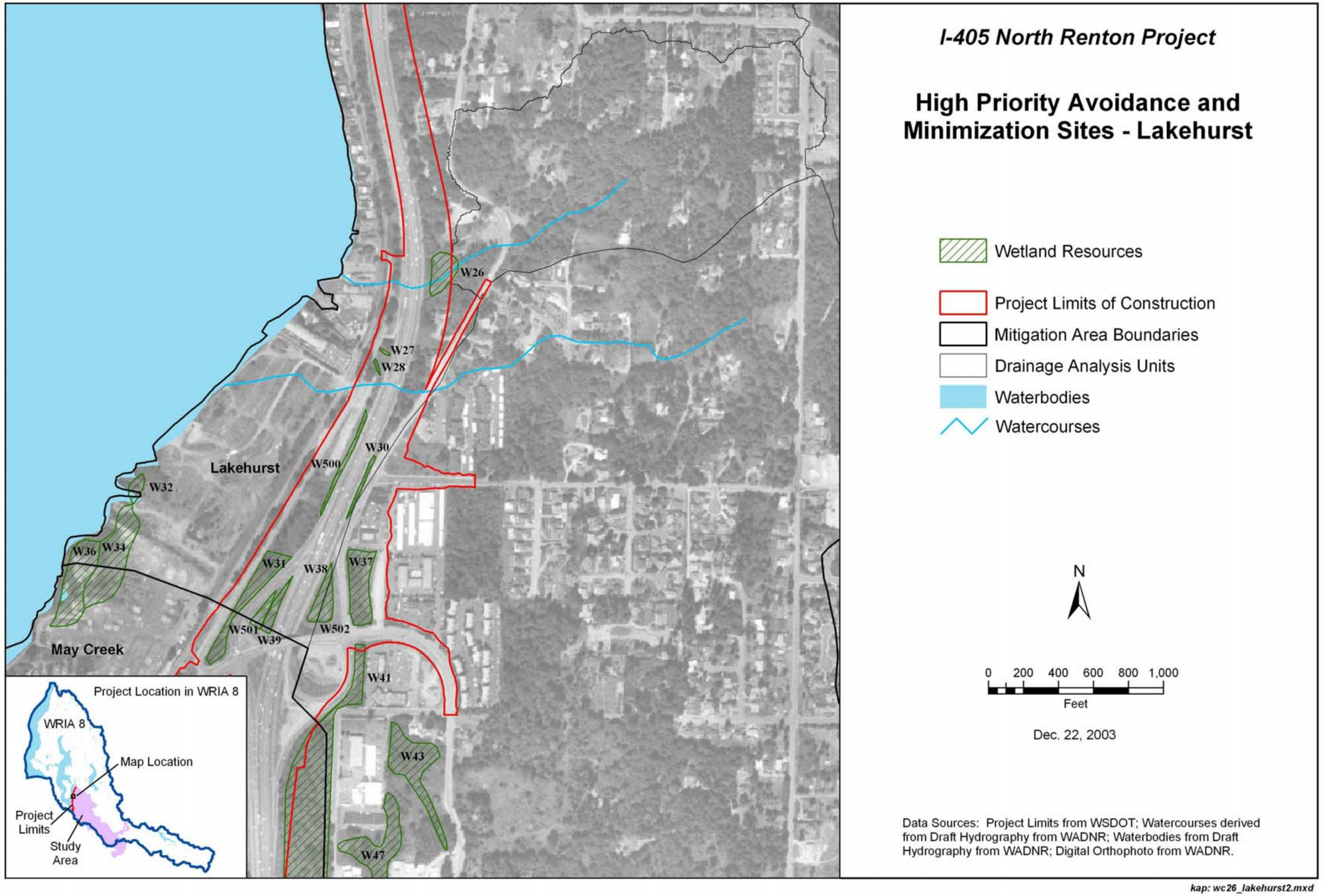


Figure 17 High Priority Avoidance and Minimization Sites: Lakehurst

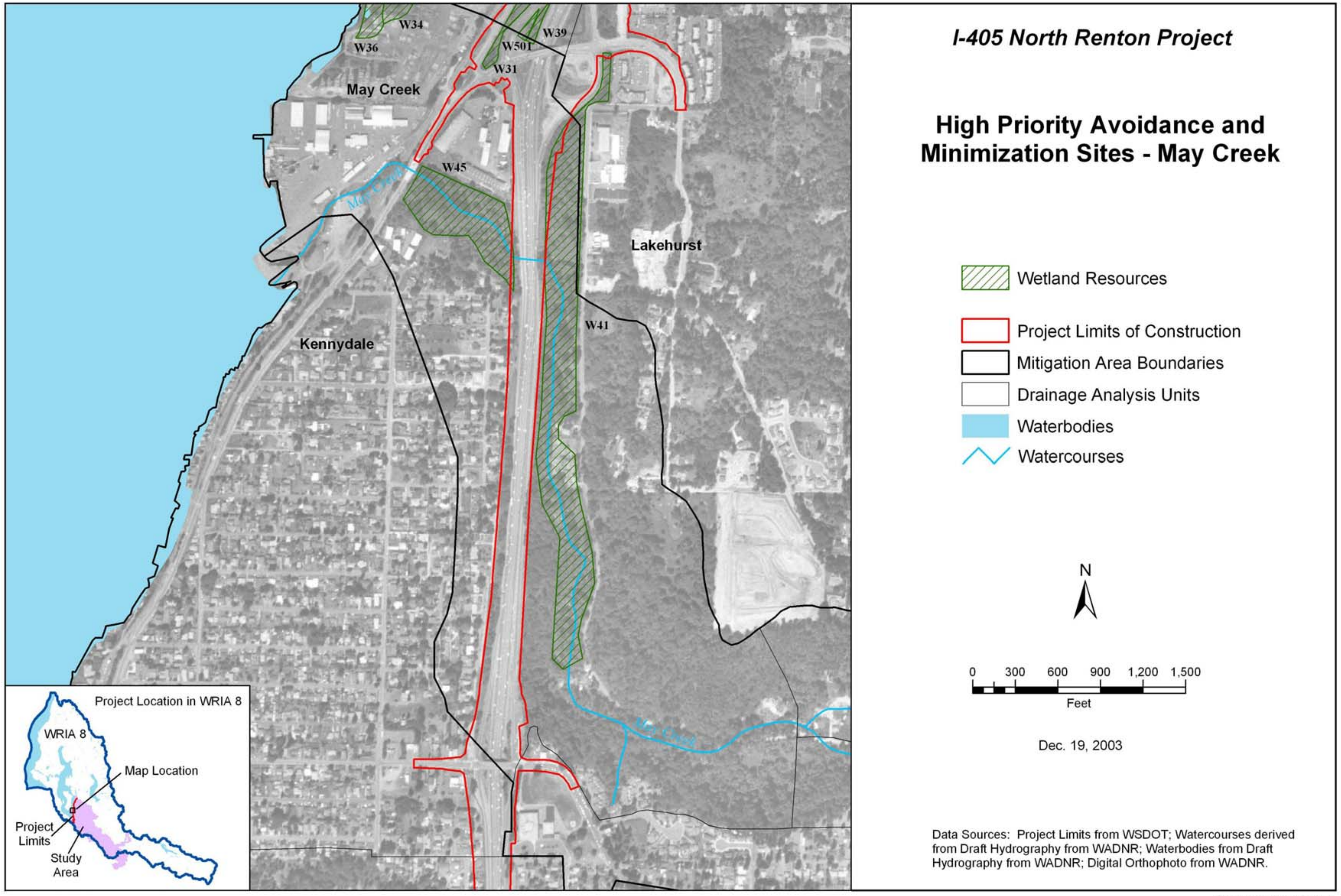


Figure 18: High Priority Avoidance and Minimization Sites: May Creek

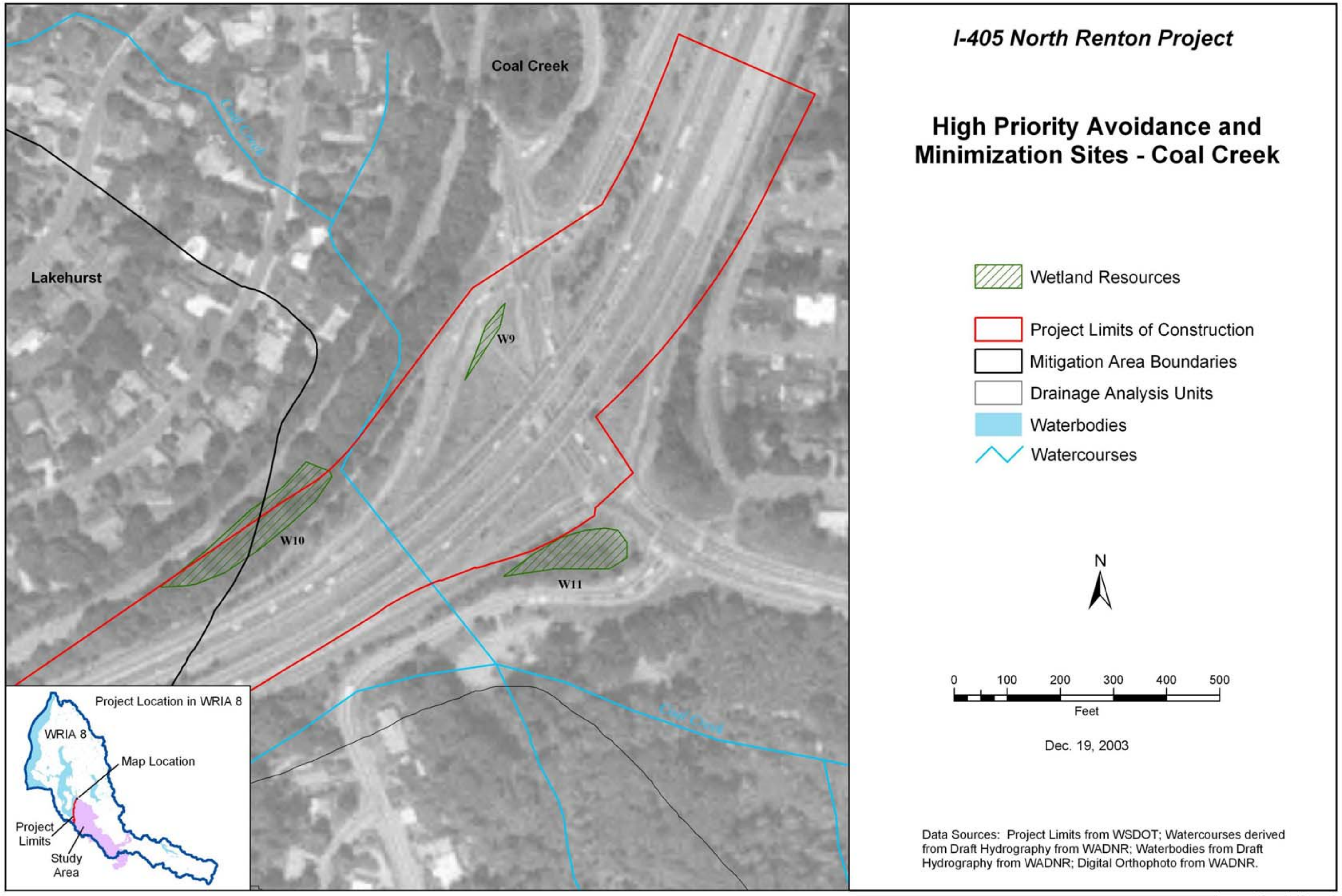


Figure 19: High Priority Avoidance and Minimization Sites: Coal Creek

We used analysis of digital orthophotos and best professional judgment to evaluate wetland resources against the criteria described above. We assigned priorities of Low, Moderate, or High to wetlands for avoidance and minimization at the site and landscape scale. We recommend that the project team use the combined overall ranking, presented in Table 14, to prioritize wetland sites for avoidance and minimization.

Table 14: Summary of Wetland Resources Within Project Limits of Construction.

Wetland ID	Ecology Rating*	Avoidance/Minimization Rank		
		Site-scale	Landscape	Overall
W9	III	Moderate	Low	Low-Mod
W10	III	Moderate	High	Mod-High
W27	III	Moderate	Moderate	Moderate
W28	III	Moderate	Moderate	Moderate
W500	III	Moderate	Low	Low-Mod
W31	II	High	Moderate	Mod-High
W45	II	High	High	High
W85	III	Moderate	Moderate	Moderate
W98	III	Moderate	Moderate	Moderate
W72	III	Moderate	Moderate	Moderate
W41	II	High	High	High
W37	III	Moderate	Moderate	Moderate
W30	III	Moderate	Low	Low-Mod
W26	II	High	High	High
W14	III	Moderate	Low	Low-Mod
W12	III	Moderate	Moderate	Moderate
W11	III	Moderate	Moderate	Moderate
Stormwater Detention Ponds				
W39	None	Low	Low	Low

W501	None	Low	Low	Low
W38	None	Low	Low	Low
W502	None	Low	Low	Low

* Ecology Rating = Categories I through IV, where I is of the highest quality rank and IV is of the least quality rank

V. Identifying Mitigation Opportunities

1. Site Selection

Natural Resources

Potential wetland, riparian, and floodplain restoration site databases developed for characterizing landscape condition were also developed and used in the identification of potential mitigation sites for stormwater, wetland, riparian, floodplain, and habitat impacts. Preliminary wetland, riparian, and floodplain data were developed through photo interpretation using 1:12,000 color stereo-paired photos. We provide a summary of each database in the watershed characterization section of this report, while detailed methods used to develop the data are presented in Gersib et al. (2004).

Stormwater Retrofit

Our assessment provided an overview of the stormwater retrofit opportunities identified by geospatial analysis and field investigations within study area. We addressed current land use, contributing land areas, soil types, treatment options, advantages, and potential obstacles, and ancillary environmental benefits within the study area. Regulators currently limit the applicability of stormwater retrofits to flow control only if they are located outside the highway right-of-way. Water quality treatment still must occur at the highway's discharge point. An exception may be made if regulators have established a water quality trading program, a total maximum daily load study (usually called a TMDL), or a water quality offset within the specific watershed in question.

> The mitigation priority lists specifically identify sites that have potential to mitigate the impacts of the transportation project. These sites include potential wetland, riparian, and floodplain restoration sites, as well as stormwater retrofit options.

The I-405 North Renton corridor is generally characterized as highly urbanized. Much of the development in the affected watersheds occurred prior to institution of stormwater and critical areas regulations. As a result, most stormwater runoff from non-highway land uses is conveyed directly to streams or Lake Washington by an elaborate network of underground pipes. In some cases, such as the North Renton/Johns Creek drainage analysis unit, nearly all surface water drainage is in the form of engineered conveyances with surface streams being largely eliminated by historic land development practices. There are several short streams that are essentially backwater areas of Lake Washington. With the exception of the Cedar River, Coal Creek, May Creek, and some tributaries, the drainage systems in the North Renton project area have little viable fish habitat. Soils are quite diverse throughout the corridor, ranging from coarse glacial outwash deposits in the southern end of the project to highly impervious clay soils north of May Creek.

Table 15 summarizes the viable stormwater retrofit sites we have identified and Figure 20 is a map showing the stormwater retrofit sites. Appendix I contains a detailed analysis of the stormwater retrofit sites.

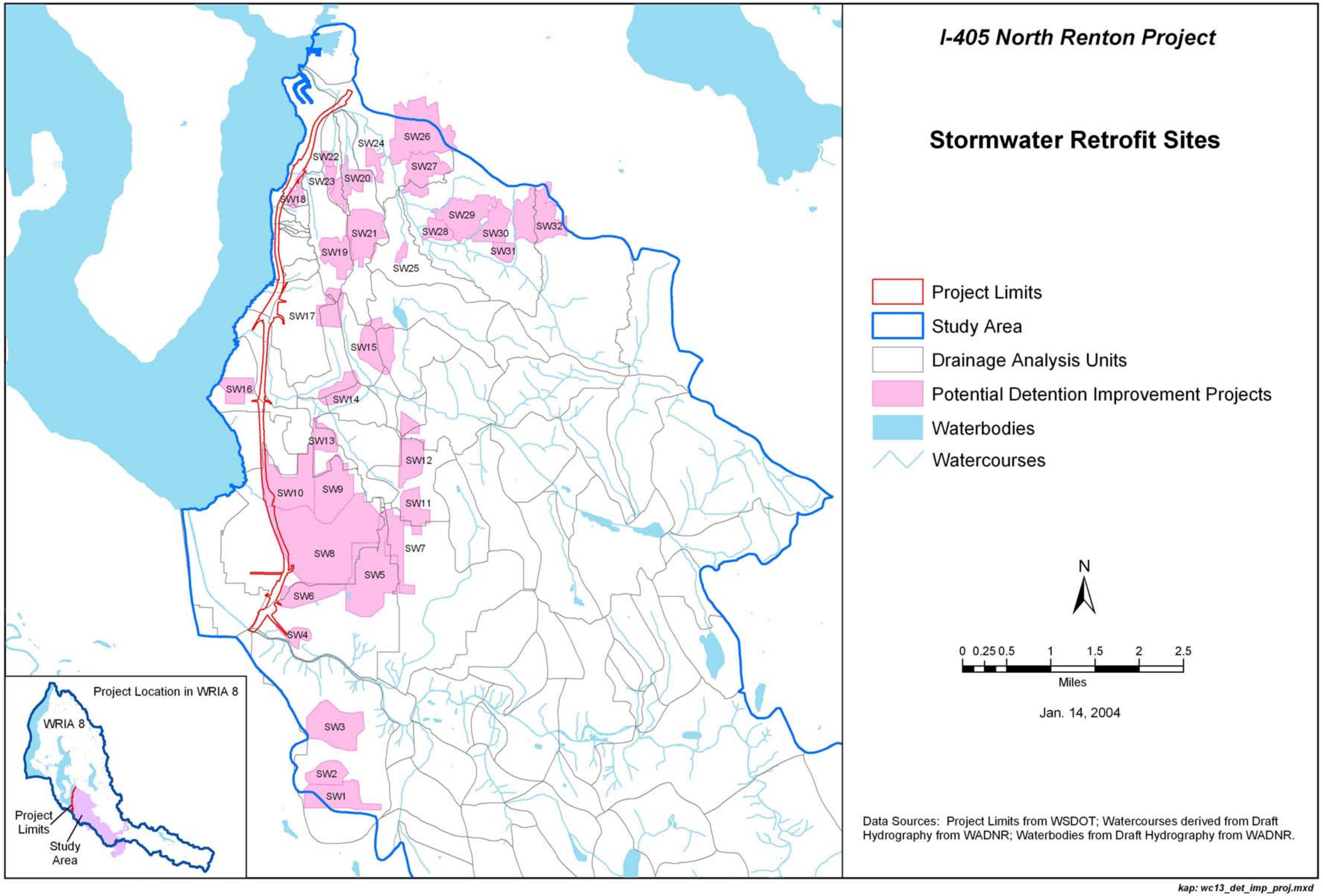


Figure 20: Map of Stormwater Retrofit Sites

Table 15: Summary of Viable Stormwater Retrofit Sites

Site Number	Analysis Area	Site description	Technical Feasibility
SW2	Cedar	SE 162nd Ave/Cascade Park	High
SW5	Cedar	Mt. Olivet NE 4th St. Quarry	High
SW7	Cedar	West Fork Maplewood Creek	High
SW3	Cedar	Royal Hill Drive SE and Lake Youngs Way SE	Moderate
SW1	Cedar	SE164th and 125th Ave SE	Low
SW4	Cedar	Maple Valley Highway	Low
SW6	Cedar	NE 3rd/NE 4th	Low
SW9	Johns Cr.	Edmonds Ave NE/NE Sunset Blvd	Moderate
SW8	Johns Cr.	N. 8th St/Sunset Blvd.	Low
SW10	Johns Cr.	Lake Washington/I-405	Low
SW17	May Cr.	SE 80th Place/118th Ave SE	High
SW11	May Cr.	Union Ave. NE/Sunset Blvd. South	Low
SW12	May Cr.	Union Ave. NE/Sunset Blvd. North	Low
SW13	May Cr.	Edmonds Ave. NE/NE 27th St.	Low
SW14	May Cr.	SE 93rd Cul-de-sac	Low
SW15	May Cr.	SW Lake Boren	Low
SW19	Lake WA	SW Newport Hills	Moderate
SW16	Lake WA	SW Kennydale	Low
SW23	Coal Cr.	Lake Heights South	High
SW27	Coal Cr.	NW quarter of the NW quarter of the SW quarter of Section 22	High
SW21	Coal Cr.	Newport Hills SE	Moderate

Site Number	Analysis Area	Site description	Technical Feasibility
SW26	Coal Cr.	Somerset/Eastgate	Moderate
SW20	Coal Cr.	Newport Hills North	Low
SW22	Coal Cr.	Lake Heights North	Low
SW24	Coal Cr.	N half of the NE quarter of Section 21	Low
SW25	Coal Cr.	E half of the NE quarter of Section 28	Low
SW28	Coal Cr.	SW 28: NW NE NW Section 27	Low
SW29	Coal Cr.	NW quarter of the NW quarter of the NE quarter of Section 27	Low
SW30	Coal Cr.	NE quarter of the NE quarter of the NE quarter of Section 27	Low
SW31	Coal Cr.	Center of the W half of the NW quarter of Section 26	Low
SW32	Coal Cr.	SE quarter of the SW quarter of the SE quarter of Section 23	Low

2. Prioritize Candidate Mitigation Sites

We developed two priority lists of mitigation opportunities, which are presented here. The stormwater mitigation priority list specifically identifies sites that have potential to mitigate stormwater flow control impacts of the transportation project. These sites include potential wetland, riparian, and floodplain restoration sites, as well as stormwater retrofit options. We based the priority of sites in the stormwater mitigation list on:

a) each site's proximity to the project area
b) anticipated environmental benefits of each site
c) location of each site in an area ranked as "At Risk" for a targeted ecological process
d) each site's listing in a local recovery plan as a priority resource for restoration
e) location in relation to public land; and
f) size

A natural resource mitigation priority list was also developed to provide options to the project management team for the mitigation of wetland, riparian, floodplain, and habitat mitigation needs of the project. This priority list evaluated potential wetland, riparian, and floodplain restoration sites using all ranking criteria for stormwater prioritization, except for the proximity of a site to the project area.

Gersib et al. (2004) presents the detailed criteria used in the ranking and prioritization of potential stormwater and natural resource mitigation sites.

Field Verification of Restoration Potential

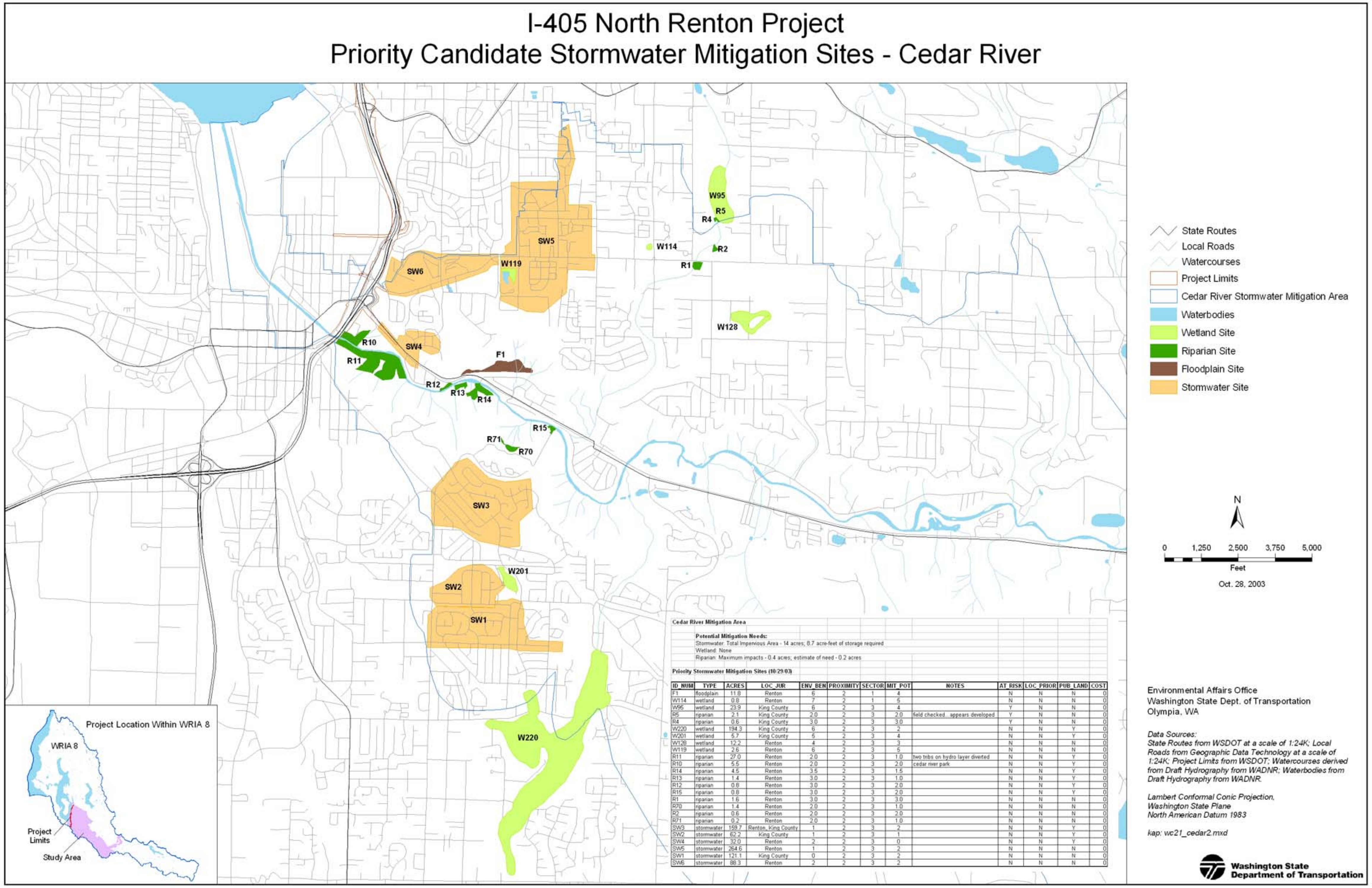
There are inherent errors associated with aerial photo interpretation. These errors warrant field verification of high priority potential restoration sites. We attempted to field verify all priority stormwater mitigation sites, with varying levels of success. We were unable to verify some sites due to a lack of access. Others we verified only from an adjacent road. Few sites have the level of site verification needed to definitively assess restoration potential. For example, we target drained and filled wetland sites for restoration potential. A visual observation from a road is all that is needed to confirm the filling of a wetland. However, to determine the restoration potential of a drained wetland, a biologist needs to walk the hydrologic outlet of the wetland to determine if the site is still being controlled by a drain. The drains are obvious in sites that are actively managed for agriculture. However, evidence exists that a number of larger wetlands were drained in the 1930s or 1940s that are no longer in agricultural production and are reverting back to forest. Without a detailed site inspection of the wetland outlet control, the true restoration potential of a site is unknown.

Potential Stormwater Mitigation Opportunities

Following the criteria above, we identified and prioritized potential stormwater mitigation opportunities. The product is a prioritized list of stormwater mitigation opportunities by mitigation area. This list is presented in Appendix A, and maps of the sites are found in Figures 21 to 26.

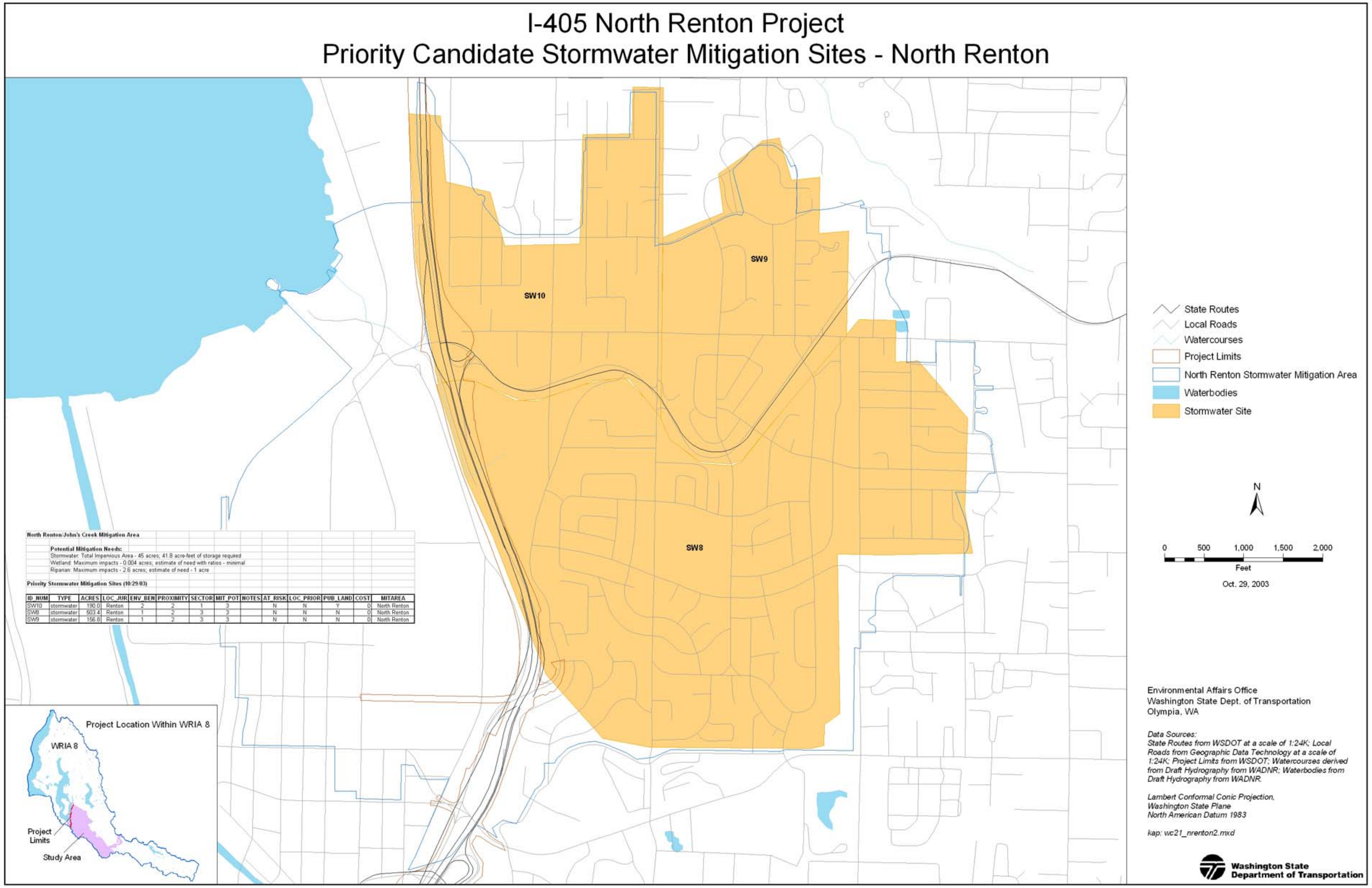
Potential Natural Resource Mitigation Opportunities

We used the same criteria summarized above to identify and prioritize potential natural resource mitigation opportunities. The product of this process is a prioritized list of wetland, riparian, and floodplain mitigation opportunities by mitigation area. This list is presented in Appendix B, and maps of the sites are found in Figures 27 to 31. Please note that there are no sites identified in the North Renton / Johns Creek area, so there is no corresponding figure.



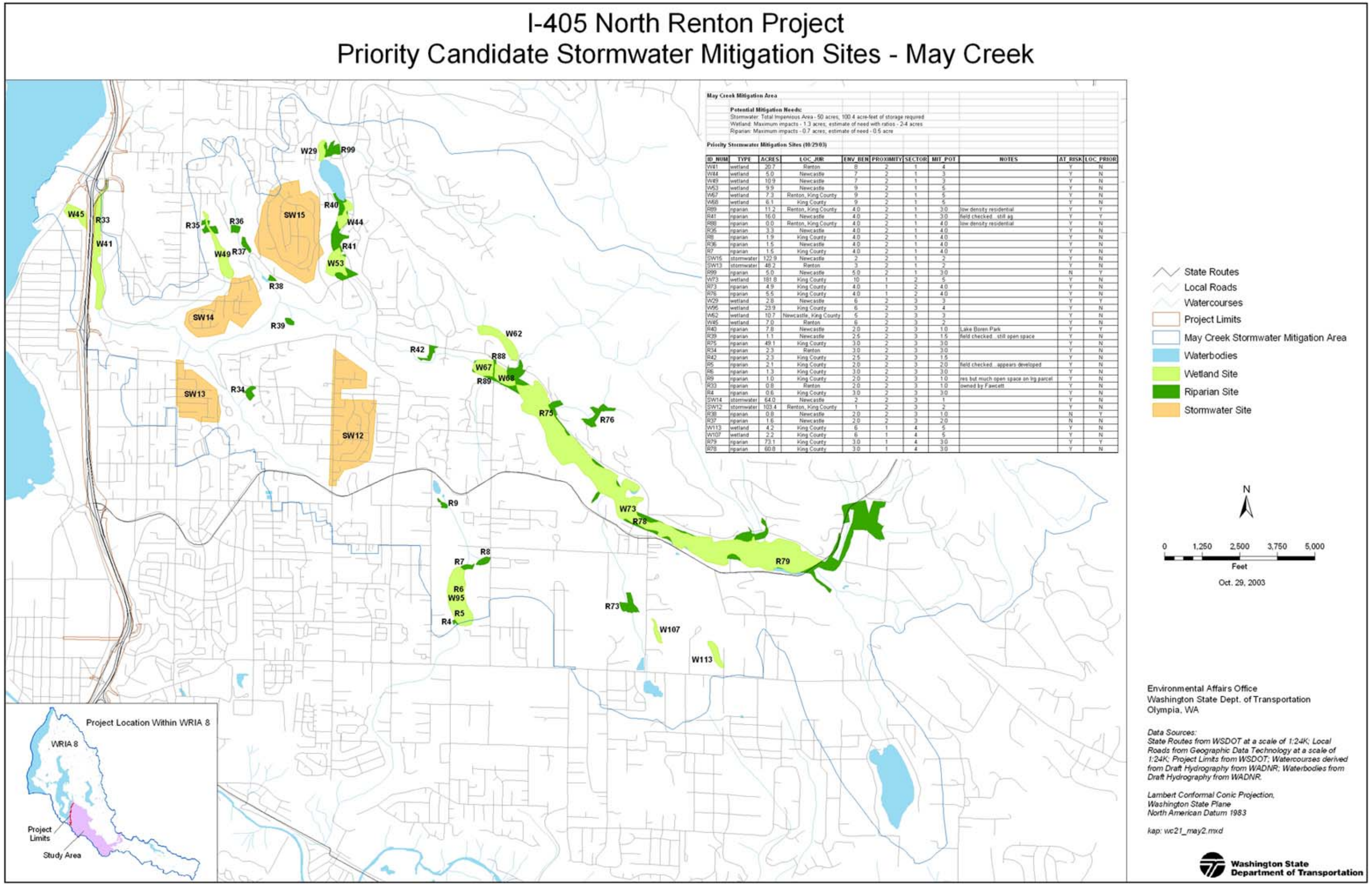
ID_NUM	TYPE	ACRES	LOC_JUR	ENV_BEN	PROXIMITY	SECTOR	MIT_POT	NOTES	AT_RISK	LOC_PRIOR	PUB_LAND	COST
F1	floodplain	11.8	Renton	6	2	1	4		N	N	N	0
W114	wetland	0.8	Renton	7	2	1	5		N	N	N	0
W95	wetland	23.9	King County	6	2	3	4		Y	N	N	0
R5	riparian	2.1	King County	2.0	2	3	2.0	field checked...appears developed	Y	N	N	0
R4	riparian	0.6	King County	3.0	2	3	3.0		Y	N	N	0
W220	wetland	194.3	King County	6	2	3	2		N	N	Y	0
W201	wetland	5.7	King County	5	2	3	4		N	N	Y	0
W128	wetland	12.2	Renton	4	2	3	3		N	N	N	0
W119	wetland	2.6	Renton	6	2	3	5		N	N	N	0
R11	riparian	27.0	Renton	2.0	2	3	1.0	two tribs on hydro layer diverted	N	N	Y	0
R10	riparian	5.5	Renton	2.0	2	3	2.0	cedar river park	N	N	Y	0
R14	riparian	4.5	Renton	3.5	2	3	1.5		N	N	Y	0
R13	riparian	1.4	Renton	3.0	2	3	1.0		N	N	Y	0
R12	riparian	0.8	Renton	3.0	2	3	2.0		N	N	Y	0
R15	riparian	0.8	Renton	3.0	2	3	2.0		N	N	Y	0
R1	riparian	1.6	Renton	3.0	2	3	3.0		N	N	N	0
R70	riparian	1.4	Renton	2.0	2	3	1.0		N	N	N	0
R2	riparian	0.6	Renton	2.0	2	3	2.0		N	N	N	0
R71	riparian	0.2	Renton	2.0	2	3	1.0		N	N	N	0
SW3	stormwater	159.7	Renton, King County	1	2	3	2		N	N	Y	0
SW2	stormwater	62.2	King County	1	2	3	1		N	N	Y	0
SW4	stormwater	32.0	Renton	2	2	3	0		N	N	Y	0
SW5	stormwater	264.6	Renton	1	2	3	2		N	N	N	0
SW1	stormwater	121.1	King County	0	2	3	2		N	N	N	0
SW6	stormwater	88.3	Renton	2	2	3	2		N	N	N	0

Figure 21: Map of Stormwater Mitigation Sites in Cedar River



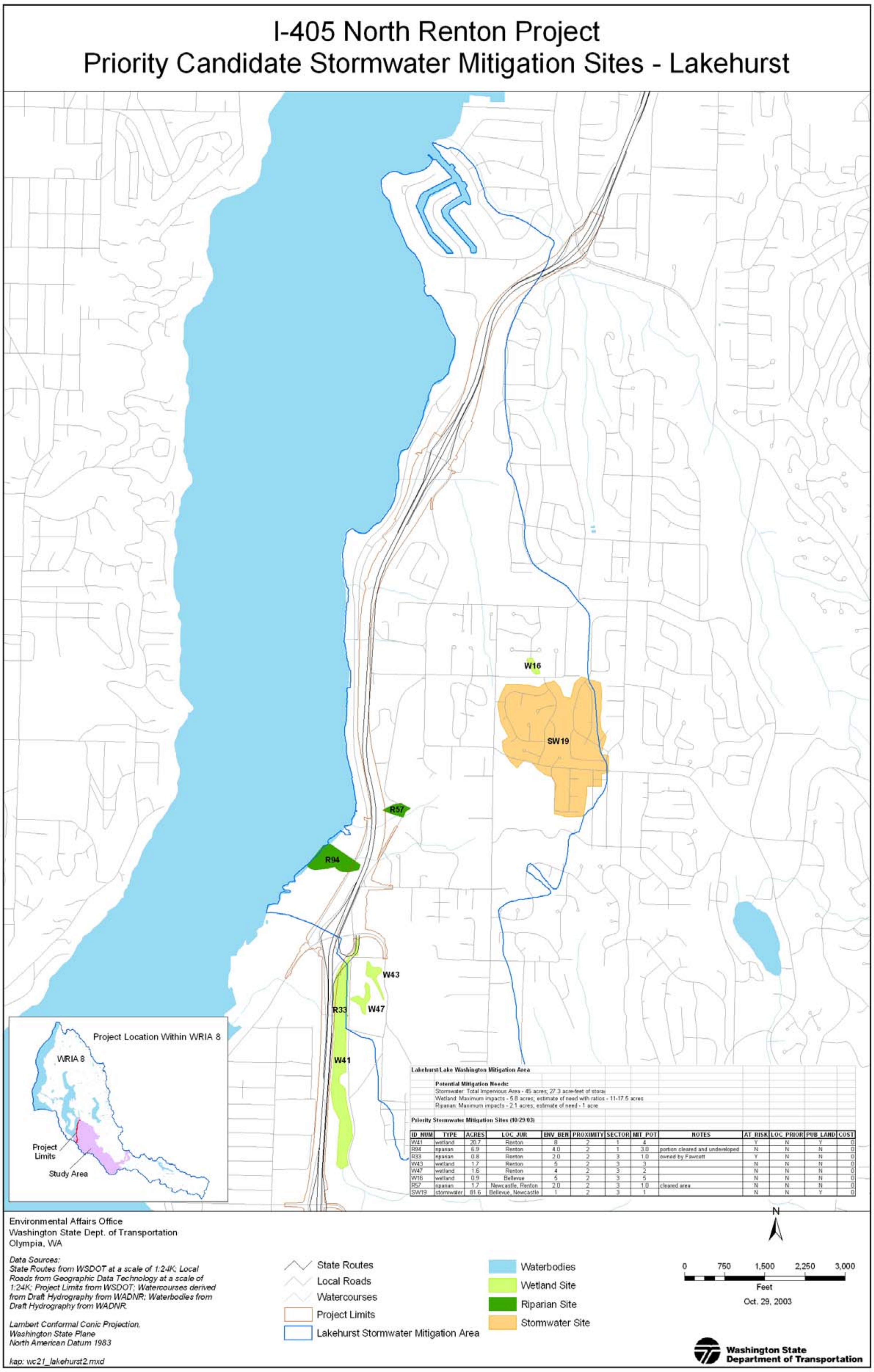
ID_NUM	TYPE	ACRES	LOC_JUR	ENV_BEN	PROXIMITY	SECTOR	MIT_POT	NOTES	AT_RISK	LOC_PRIOR	PUB_LAND	COST	MITAREA
SW10	stormwater	190.0	Renton	2	2	1	3		N	N	Y	0	North Renton
SW8	stormwater	503.4	Renton	1	2	3	3		N	N	N	0	North Renton
SW9	stormwater	156.8	Renton	1	2	3	3		N	N	N	0	North Renton

Figure 22: Map of Stormwater Mitigation Sites in Johns Creek / North Renton



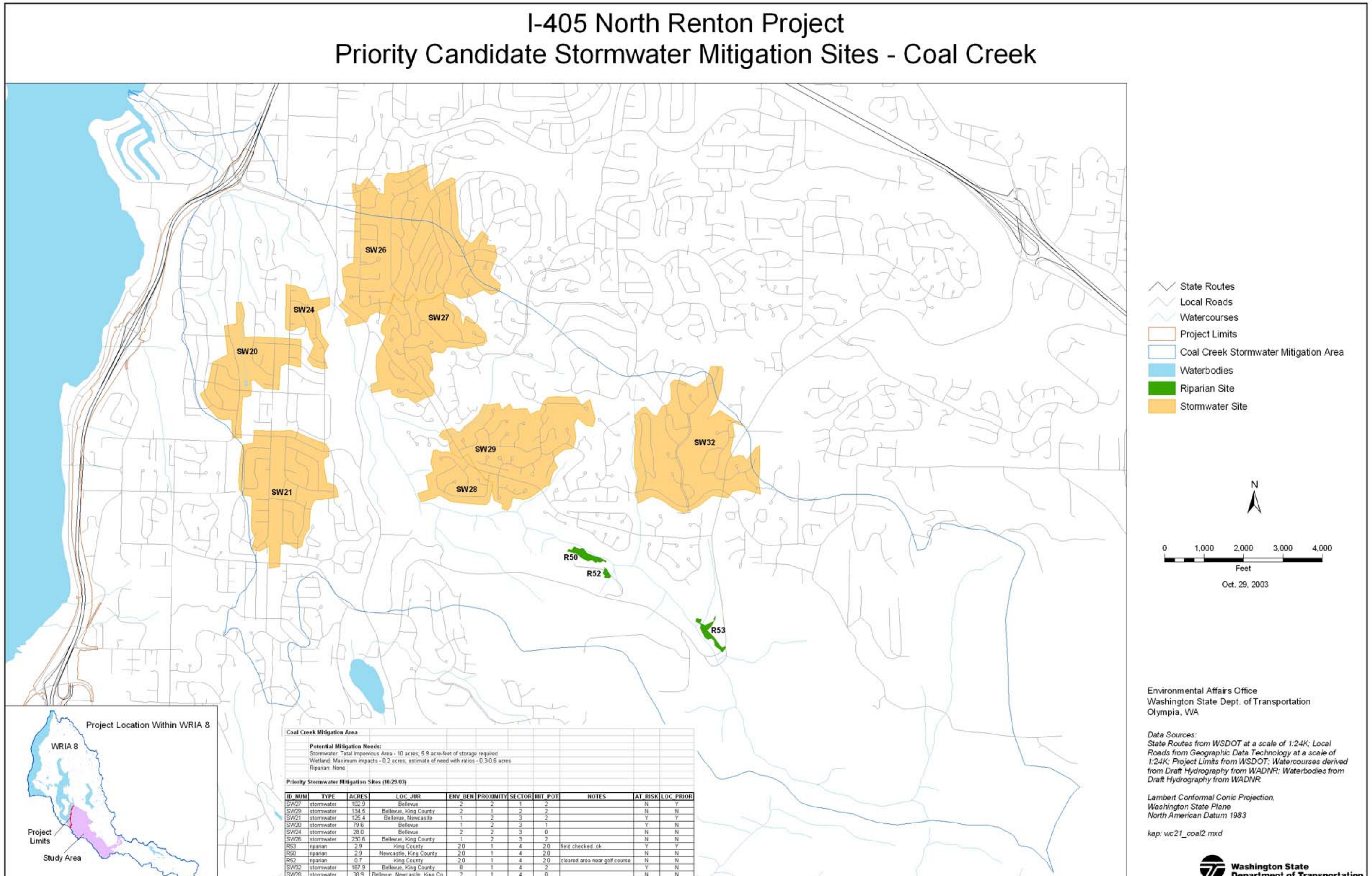
ID_NUM	TYPE	ACRES	LOC_JUR	ENV_BEN	PROXIMITY	SECTOR	MIT_POT	NOTES	AT_RISK	LOC_PRIOR
W41	wetland	20.7	Renton	8	2	1	4		Y	N
W44	wetland	5.0	Newcastle	7	2	1	3		Y	N
W49	wetland	10.9	Newcastle	7	2	1	3		Y	N
W53	wetland	9.9	Newcastle	9	2	1	5		Y	N
W67	wetland	7.3	Renton, King County	9	2	1	5		Y	N
W68	wetland	6.1	King County	9	2	1	5		Y	N
R89	riparian	11.2	Renton, King County	4.0	2	1	3.0	low density residential	Y	Y
R41	riparian	16.0	Newcastle	4.0	2	1	3.0	field checked... still ag	Y	Y
R88	riparian	0.0	Renton, King County	4.0	2	1	4.0	low density residential	Y	N
R35	riparian	3.3	Newcastle	4.0	2	1	4.0		Y	N
R8	riparian	1.9	King County	4.0	2	1	4.0		Y	N
R36	riparian	1.5	Newcastle	4.0	2	1	4.0		Y	N
R7	riparian	1.5	King County	4.0	2	1	4.0		Y	N
SW15	stormwater	122.9	Newcastle	2	2	1	2		Y	N
SW13	stormwater	48.2	Renton	3	2	1	2		Y	N
R99	riparian	5.0	Newcastle	5.0	2	1	3.0		N	Y
W73	wetland	181.8	King County	10	1	2	5		Y	N
R73	riparian	4.9	King County	4.0	1	2	4.0		Y	N
R76	riparian	5.5	King County	4.0	1	2	4.0		Y	N
W29	wetland	2.8	Newcastle	6	2	3	3		Y	Y
W95	wetland	23.9	King County	6	2	3	4		Y	N
W62	wetland	10.7	Newcastle, King County	5	2	3	3		Y	N
W45	wetland	7.0	Renton	6	2	3	2		Y	N
R40	riparian	7.8	Newcastle	2.0	2	3	1.0	Lake Boren Park	Y	Y
R39	riparian	1.1	Newcastle	2.5	2	3	1.5	field checked... still open space	Y	N
R75	riparian	49.1	King County	3.0	2	3	3.0		Y	N
R34	riparian	2.3	Renton	3.0	2	3	3.0		Y	N
R42	riparian	2.3	King County	2.5	2	3	1.5		Y	N
R5	riparian	2.1	King County	2.0	2	3	2.0	field checked... appears developed	Y	N
R6	riparian	1.3	King County	3.0	2	3	3.0		Y	N
R9	riparian	1.0	King County	2.0	2	3	1.0	res but much open space on lrg parcel	Y	N
R33	riparian	0.8	Renton	2.0	2	3	1.0	owned by Fawcett	Y	N
R4	riparian	0.6	King County	3.0	2	3	3.0		Y	N
SW14	stormwater	64.0	Newcastle	2	2	3	1		Y	N
SW12	stormwater	103.4	Renton, King County	1	2	3	2		Y	N
R38	riparian	0.8	Newcastle	2.0	2	3	1.0		N	Y
R37	riparian	1.6	Newcastle	2.0	2	3	2.0		N	N
W113	wetland	4.2	King County	6	1	4	5		Y	N
W107	wetland	2.2	King County	6	1	4	5		Y	N
R79	riparian	73.1	King County	3.0	1	4	3.0		Y	Y
R78	riparian	60.8	King County	3.0	1	4	3.0		Y	N

Figure 23: Map of Stormwater Mitigation Sites in May Creek



ID_NUM	TYPE	ACRES	LOC_JUR	ENV_BEN	PROXIMITY	SECTOR	MIT_POT	NOTES	AT_RISK	LOC_PRIOR	PUB_LAND	COST
W41	wetland	20.7	Renton	8	2	1	4		Y	N	Y	0
R94	riparian	6.9	Renton	4.0	2	1	3.0	portion cleared and undeveloped	N	N	N	0
R33	riparian	0.8	Renton	2.0	2	3	1.0	owned by Fawcett	Y	N	N	0
W43	wetland	1.7	Renton	5	2	3	3		N	N	N	0
W47	wetland	1.6	Renton	4	2	3	2		N	N	N	0
W16	wetland	0.9	Bellevue	5	2	3	5		N	N	N	0
R57	riparian	1.7	Newcastle, Renton	2.0	2	3	1.0	cleared area	N	N	N	0
SW19	stormwater	81.6	Bellevue, Newcastle	1	2	3	1		N	N	Y	0

Figure 24: Map of Stormwater Mitigation Sites in Lakehurst



ID_NUM	TYPE	ACRES	LOC_JUR	ENV_BEN	PROXIMITY	SECTOR	MIT_POT	NOTES	AT_RISK	LOC_PRIOR
SW27	stormwater	102.9	Bellevue	2	2	1	2		N	Y
SW29	stormwater	134.5	Bellevue, King County	2	1	2	2		N	N
SW21	stormwater	125.4	Bellevue, Newcastle	1	2	3	2		Y	Y
SW20	stormwater	79.6	Bellevue	1	2	3	1		Y	N
SW24	stormwater	28.0	Bellevue	2	2	3	0		N	N
SW26	stormwater	230.6	Bellevue, King County	1	2	3	2		N	N
R53	riparian	2.9	King County	2.0	1	4	2.0	field checked..ok	Y	Y
R50	riparian	2.9	Newcastle, King County	2.0	1	4	2.0		N	N
R52	riparian	0.7	King County	2.0	1	4	2.0	cleared area near golf course	N	N
SW32	stormwater	167.9	Bellevue, King County	0	1	4	2		Y	N
SW28	stormwater	38.9	Bellevue, Newcastle, King Co.	2	1	4	0		N	N

Figure 25: Map of Stormwater Mitigation Sites in Coal Creek

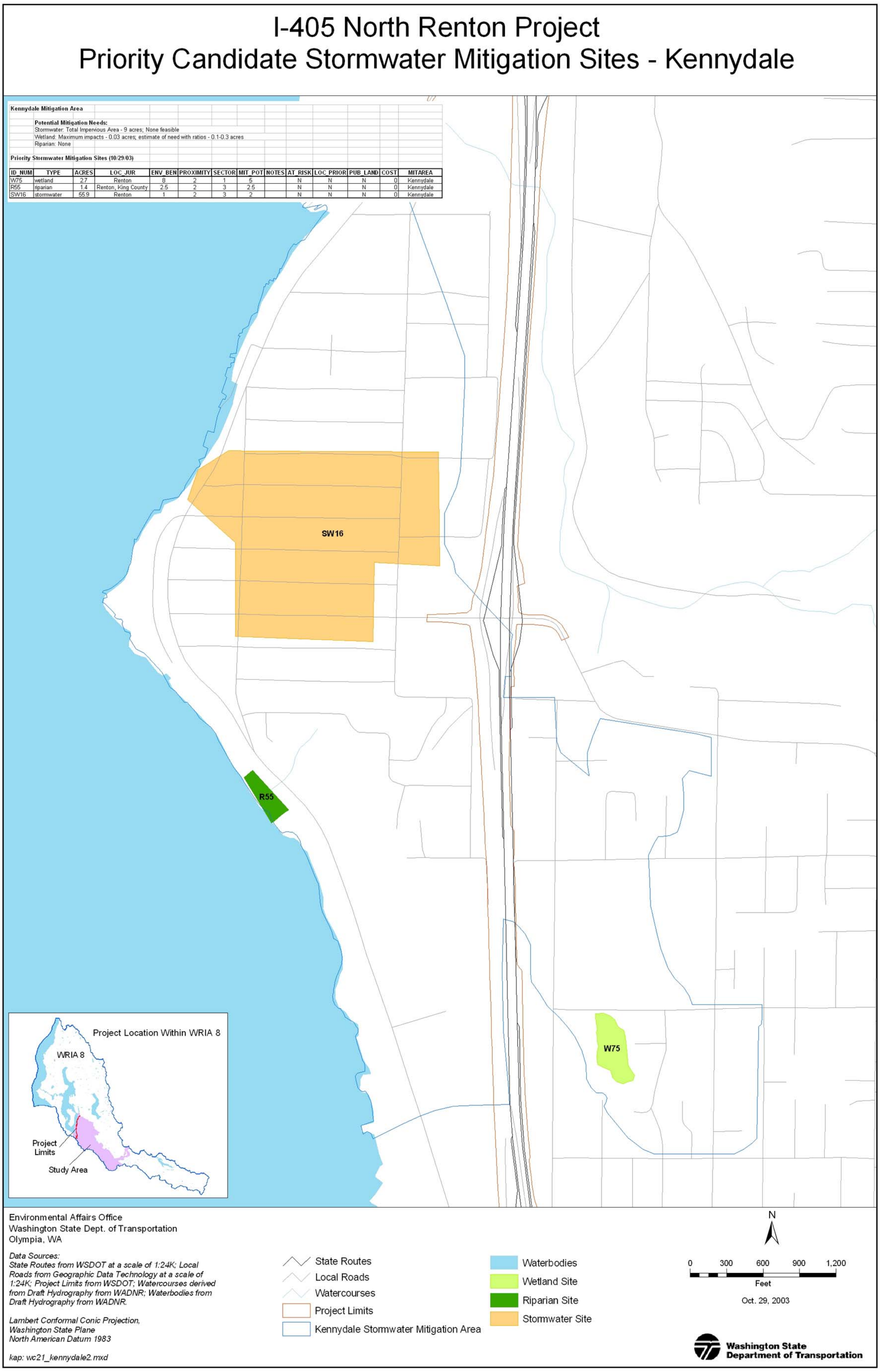


Figure 26: Map of Stormwater Mitigation Sites in Kennydale

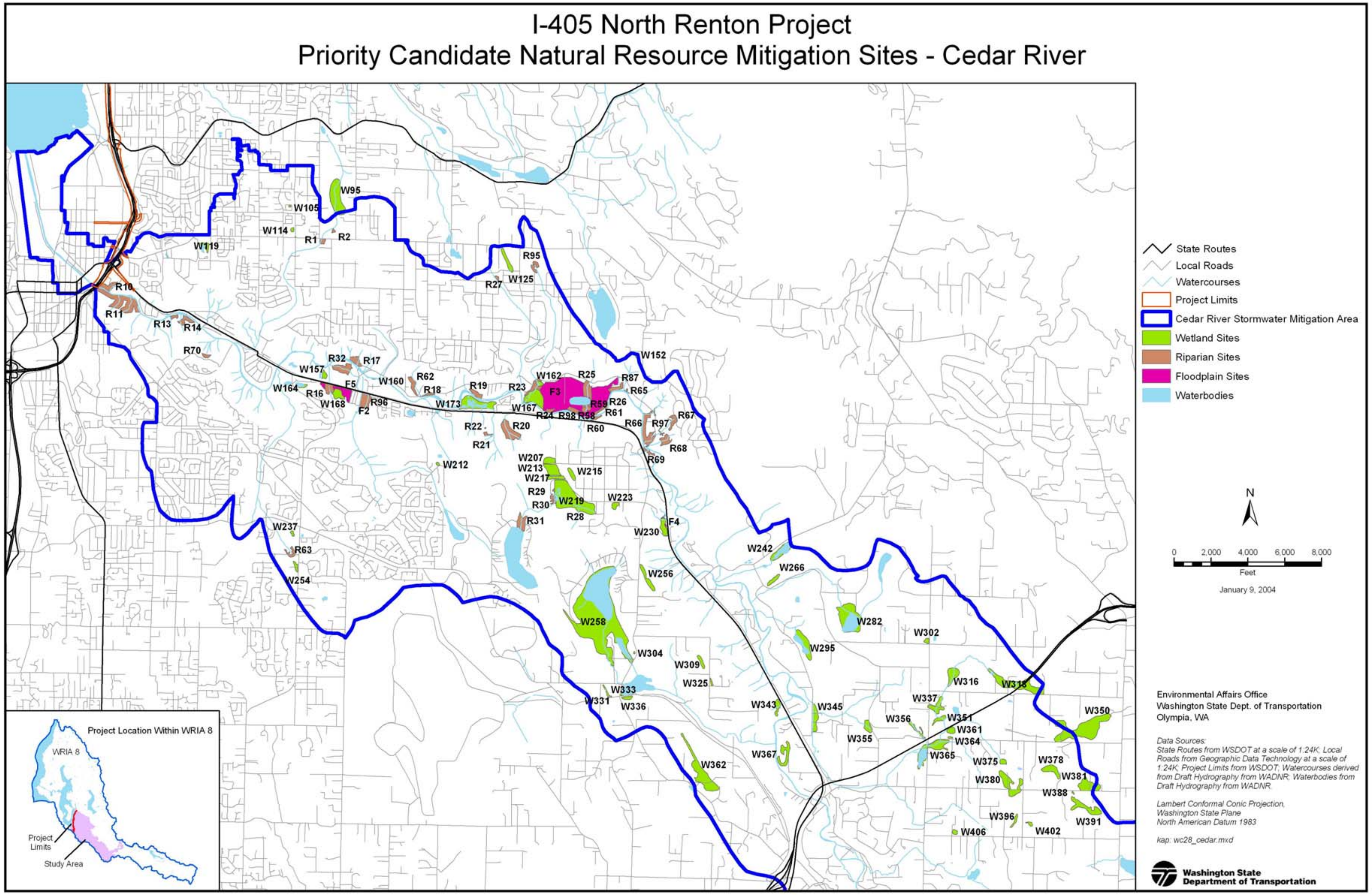


Figure 27: Map of Natural Resource Mitigation Sites in Cedar River

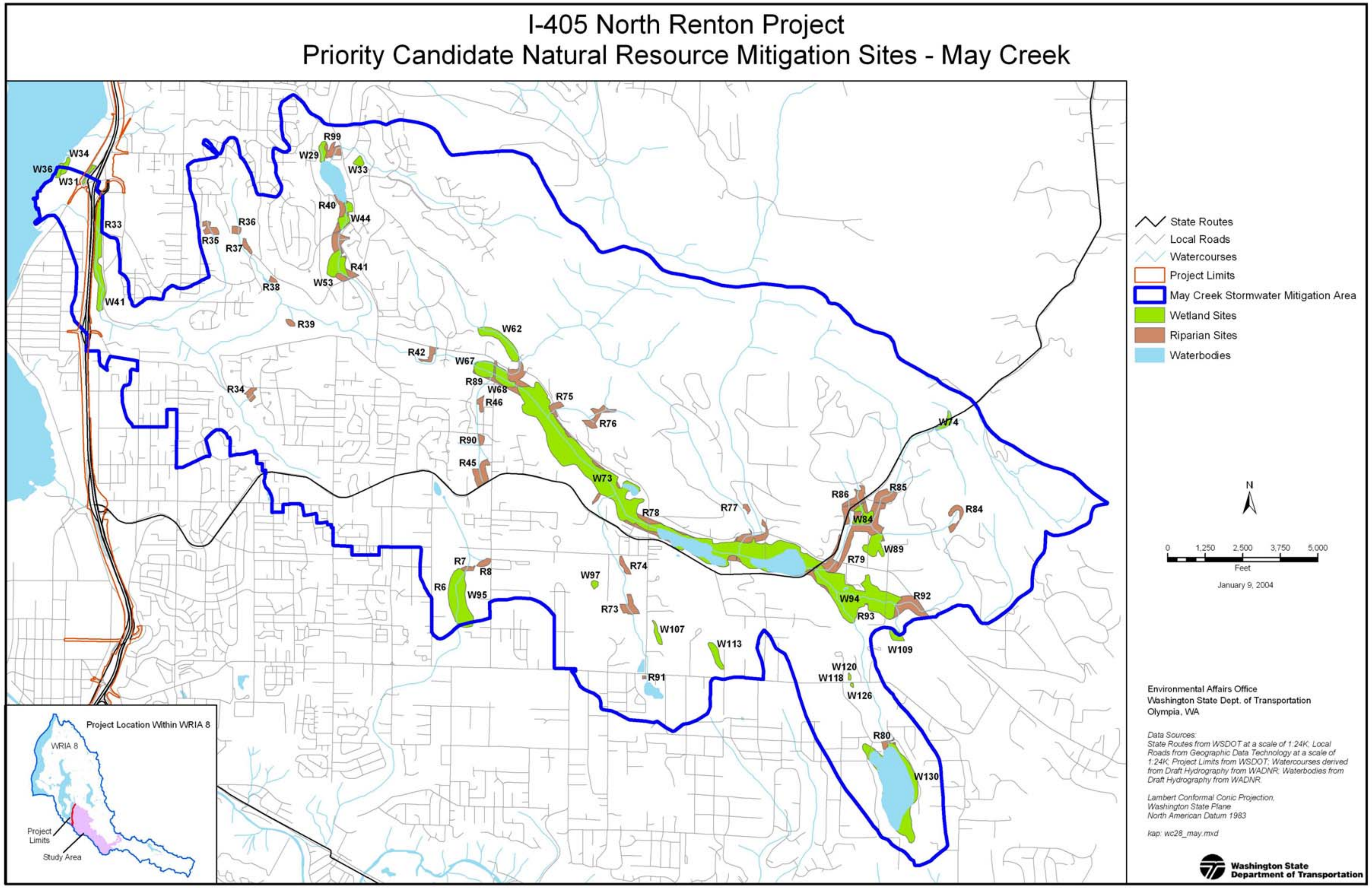


Figure 28: Map of Natural Resource Mitigation Sites in May Creek

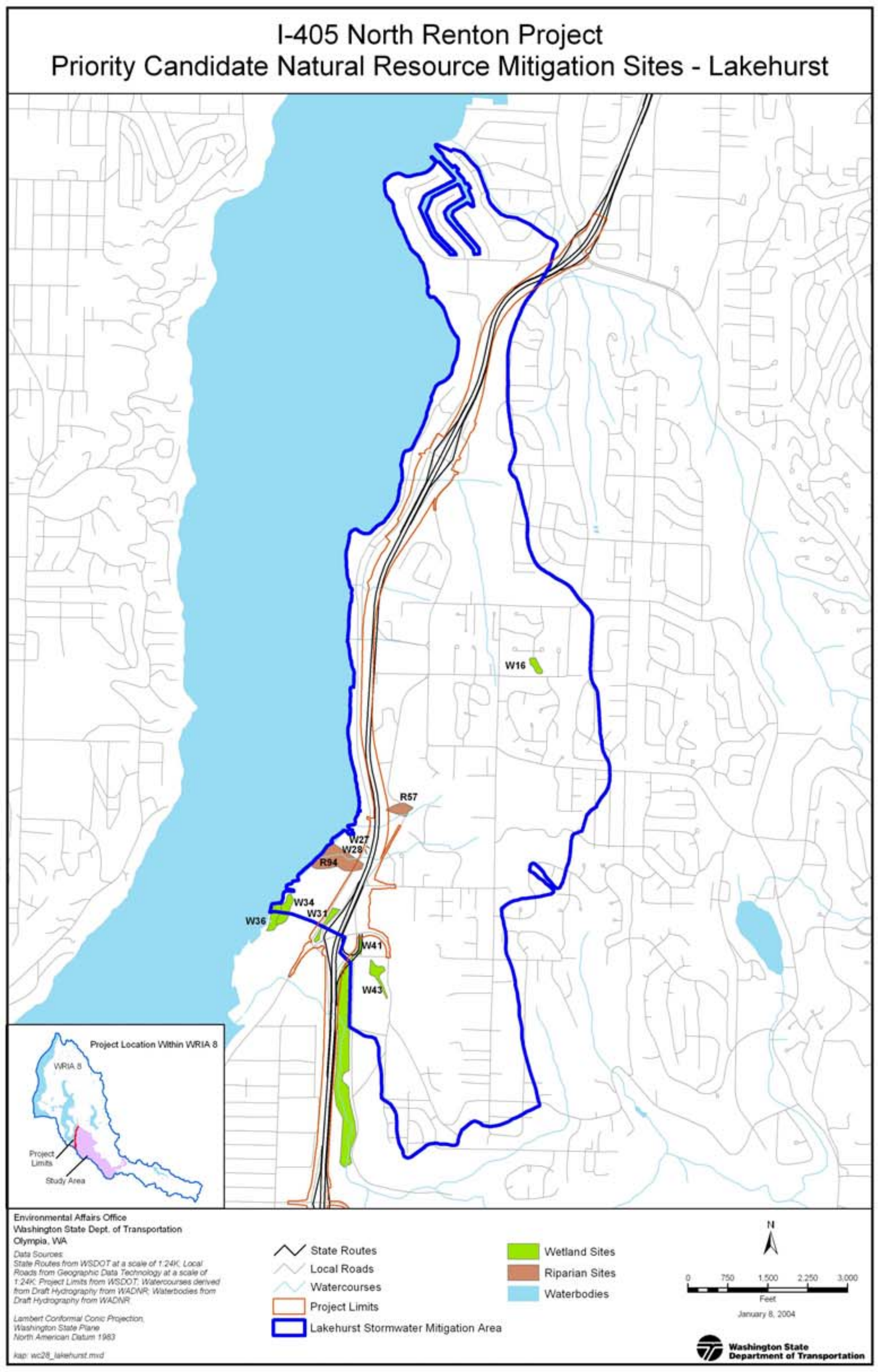


Figure 29: Map of Natural Resource Mitigation Sites in Lakehurst

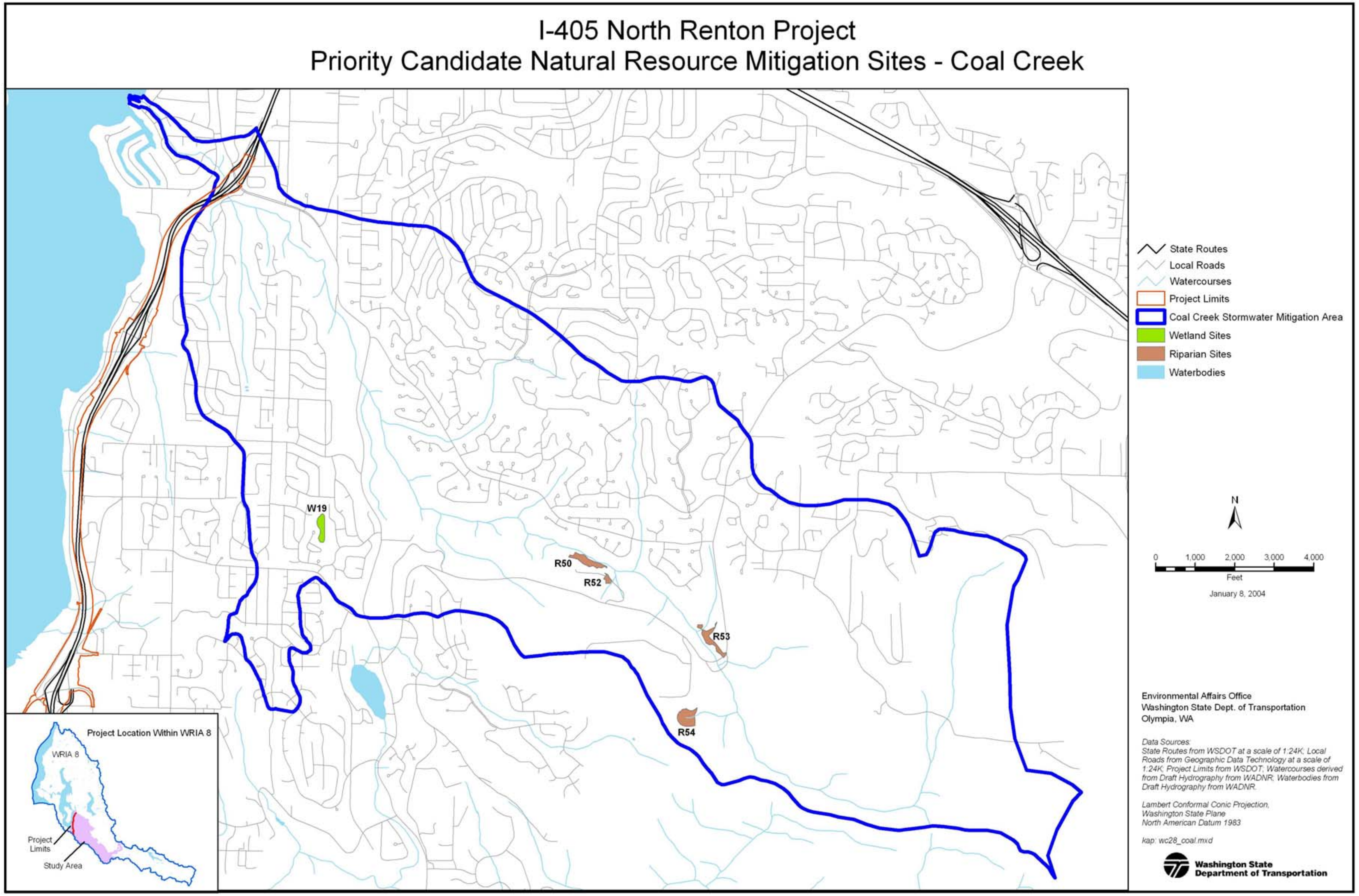


Figure 30: Map of Natural Resource Mitigation Sites in Coal Creek

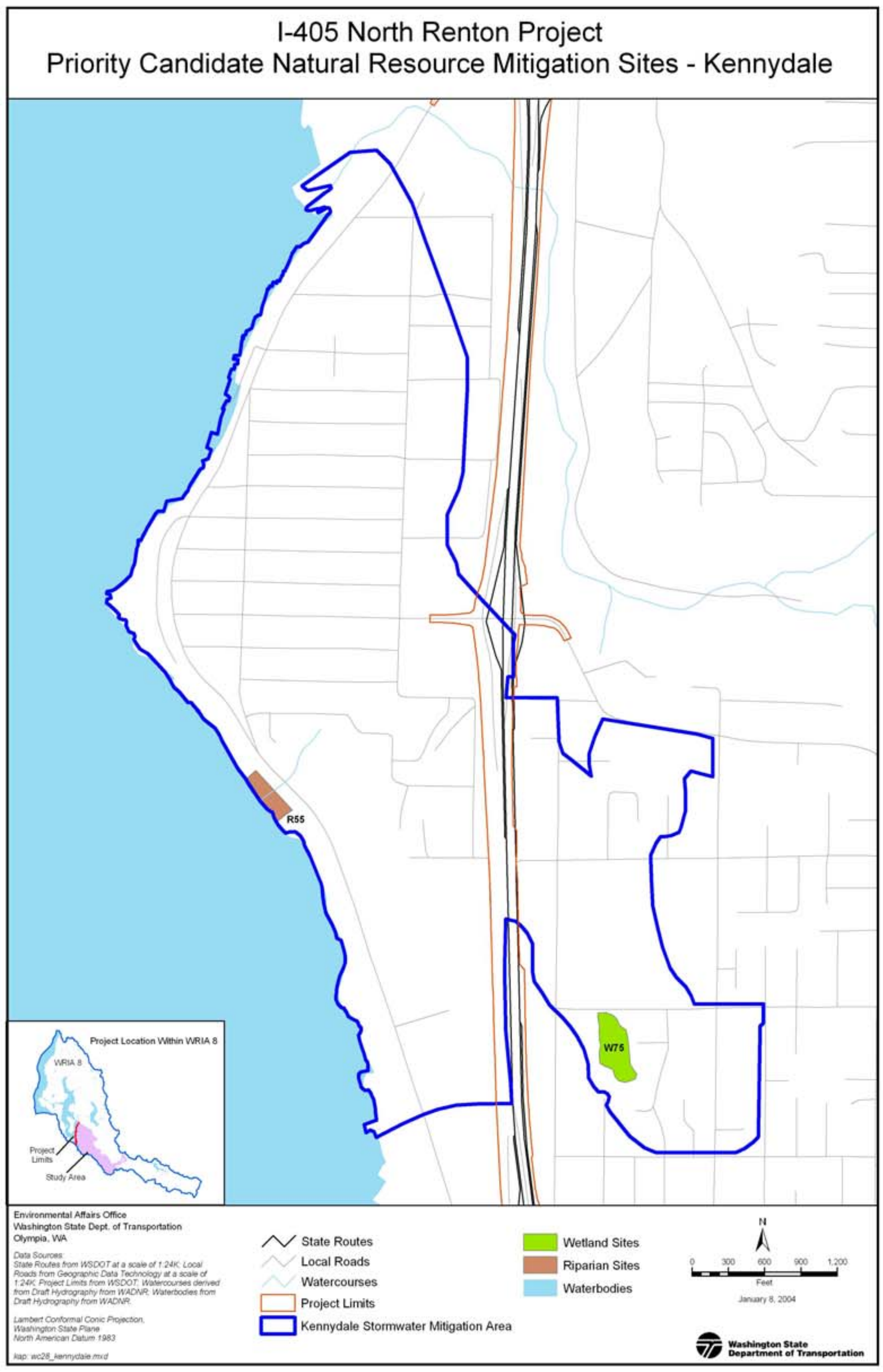


Figure 31: Map of Natural Resource Mitigation Sites in Kennydale

3. Alternative Mitigation Recommendations

Our goal is to provide the project management team with information and alternative mitigation options having potential to increase environmental benefits and reduce mitigation costs. The stormwater and natural resource mitigation options presented above represent the best recommendation of the technical team for achieving this goal.

Stormwater flow control and water quality treatment needs for this project are substantial. We recommend that the Low Impact Development work by Dr. Chris May be considered along with the standard stormwater Best Management Practices for in right-of-way stormwater quality and quantity treatment. We further recommend that high priority wetland restoration and/or stormwater retrofit sites on the stormwater mitigation priority list be considered as additional opportunities to meet project flow control needs outside the project right-of-way. We continue to work with technical staff at the Department of Ecology to quantify the effectiveness of restoring wetlands and riparian areas to help meet project flow control needs. Progress on the use and effectiveness of wetland and riparian restoration options will be immediately conveyed to project staff.

We present detailed lists of stormwater and natural resource mitigation option sites in Appendices A and B.

We recommend that wetland, riparian, and floodplain mitigation sites in the natural resource mitigation priority list be considered along with existing options identified in local planning documents.

This is the first watershed characterization project that results in a priority list of mitigation options. While we feel comfortable with the results, we also recognize that this approach is still in development. We commit to working closely with project environmental staff to ensure that our developing methods and resulting products meet both your expectations and needs.

References

Azous, Amanda L. and R.R. Horner. 1997. Wetlands and Urbanization; Implications for the Future. Washington Department of Ecology, King County Land and Water Resources Division, and the Univ. of Washington, Seattle.

Booth, Derek and C. Rhett Jackson. 1997. Urbanization of Aquatic Systems: Degradation Thresholds, Stormwater Detection, and the Limits of Mitigation. Journal of the American Water Resources Association, Vol. 33(5). October.

Booth, et al. 2001. Urban Stream Rehabilitation in the Pacific Northwest. Final Report for EPA Grant No. R82-5284-010. March.

Buchanan, Kurt, 2003. Stream Habitat Conditions During Low Flow Conditions – Coal Creek, May Creek, Lower Cedar River, and Selected Tributaries. Prepared for the I-405 North Renton Watershed Characterization Study for the Washington State Dept. of Transportation.

City of Bellevue and King County, Washington, 1987. Coal Creek Basin Plan and Draft Environmental Impact Statement.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS 79/31.

Ecology. 1993. Washington State Wetlands Rating System, Western Washington (second edition). Washington State Department of Ecology. Publication #93-74.

Ecology. 1997. Washington State Wetlands Identification and Delineation Manual. Department of Ecology, Publication #96-94. Lacy, WA.

Foster Wheeler Environmental Corp., 1995. May Creek Current and Future Conditions Report. Prepared for King County and the City of Renton.

Karr, J. R. and D. R. Dudley. 1981. Ecological perspectives on water quality goals. Environmental Management 5: 55-68.

Kerwin, J. 2001. Salmon and Steelhead Habitat Limiting Factors Report for the Cedar-Sammamish Basin. Washington Conservation Commission, Olympia, WA.

King County and the City of Renton. 2001. May Creek Basin Action Plan.

King County Department of Public Works. 1993. Cedar River Current and Future Conditions Report.

King County Streams Monitoring Program Website, 2003. Data Summaries for May and Coal Creeks. http://dnr.metrokc.gov/wlr/waterres/streams.

Metropolitan King County Council, 1997. Lower Cedar River Basin and Nonpoint Pollution Action Plan.

MGS Engineering Consultants, Inc. 2002. MGS Flood Continuous Flow Model for Stormwater Facility Design. Developed for the Washington State Department of Transportation.

Northwest Hydraulic Consultants, Inc. 1997. Coal Creek Studies – Hydraulic Analysis. July 1 Technical Memorandum to Spearman Engineering, for the City of Bellevue.

Washington State Department of Ecology. 1998. 1998 Statewide Water Quality Assessment 303(d) Report.

Washington State Department of Ecology. 2003. Environmental Information Management System, On-line searchable database.

WSDOT. 2000. Wetland functions characterization tool for linear projects; by W. Null, G. Skinner, and W. Leonard. Washington State Department of Transportation, Environmental Affairs Office. Olympia.

WSDOT. 2000. I-405 Congestion Relief and Bus Rapid Transit Projects, Corridor Final Environmental Impact Statement. 2002

Young, G.K., et al. 1996. Evaluation and Management of Highway Runoff Quality. FHWA-PD-96-032. Office of Environment and Planning, US Department of Transportation, Federal Highway Administration, Washington, DC.